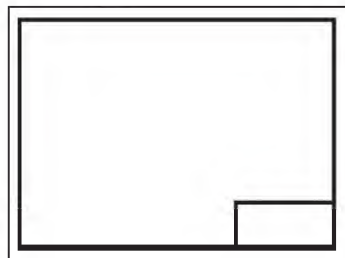
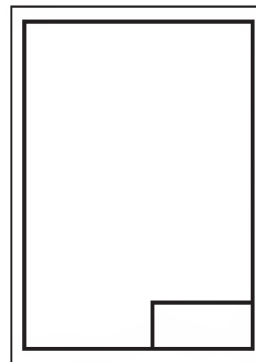


Table 2.1 Preferred drawing sheet sizes (First choice) ISO-A Series

<i>Designation</i>	<i>Dimensions (mm)</i>
A0	841 × 1189
A1	594 × 841
A2	420 × 594
A3	297 × 420
A4	210 × 297



(a)



(b)

- (i) Title of the drawing
- (ii) Sheet number
- (iii) Scale
- (iv) Symbol, denoting the method of projection
- (v) Name of the firm
- (vi) Initials of staff drawn, checked and approved.

Fig. 2.2 Location of title block

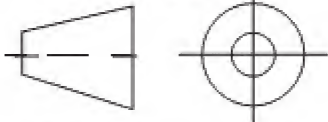
170						
65		NAME	DATE	MATERIAL	TOLERANCE	FINISH
	DRN					
	CHD					
	APPD					
	PROJECTION		LEGAL OWNER	TITLE		
						
SCALE				IDENTIFICATION NUMBER		

Fig. 2.3 Details in title block

SCALE 1 : 1 for full size,
 SCALE \times : 1 for enlarged scales,
 SCALE 1 : \times for reduced scales.

Category	Recommended Scales		
Enlarged scales	50:1	20:1	10:1
	5:1	2:1	
Full size			1:1
Reduced scales	1:2	1:5	1:10
	1:20	1:50	1:100
	1:200	1:500	1:1000
	1:2000	1:5000	1:10000

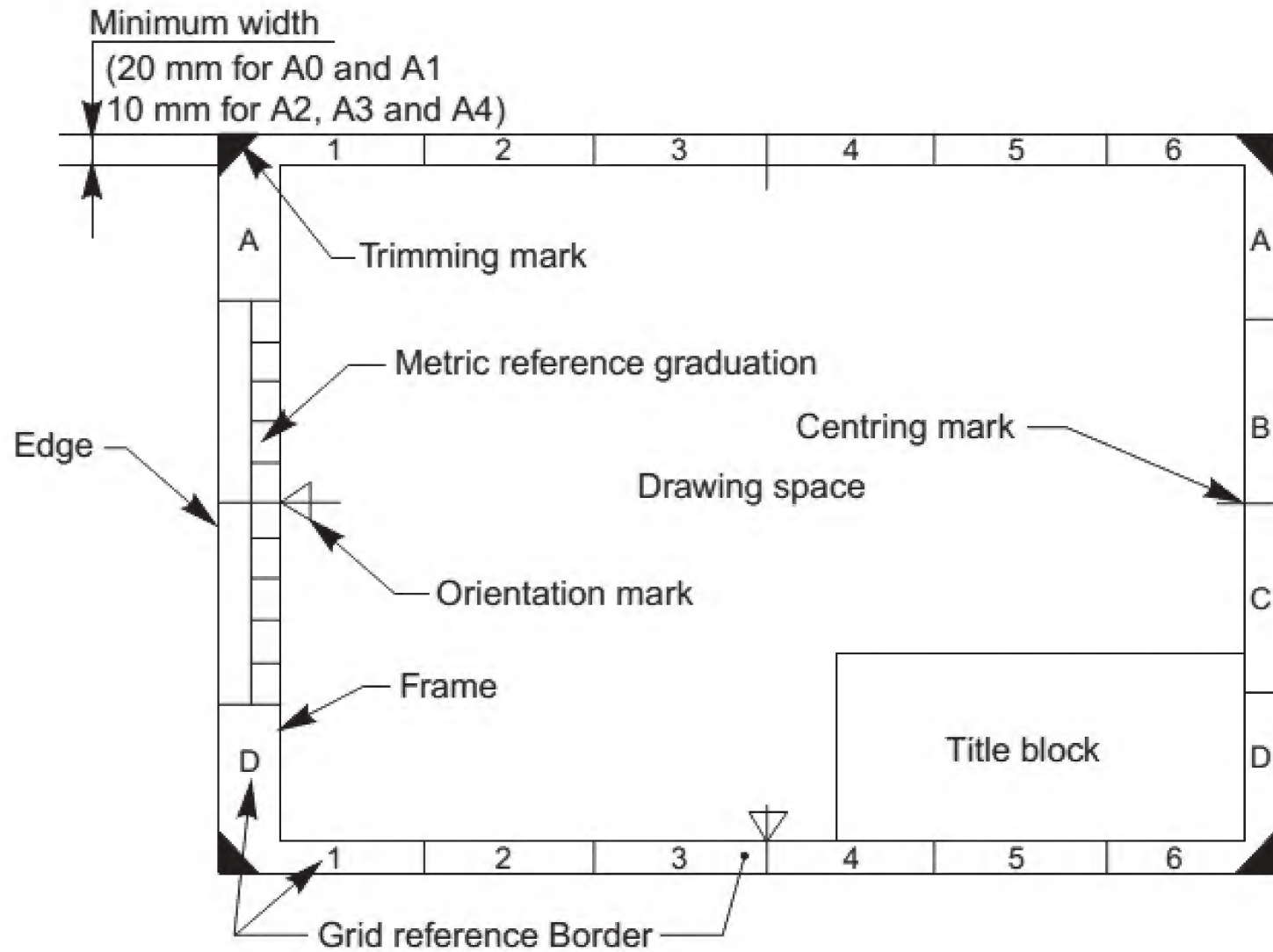




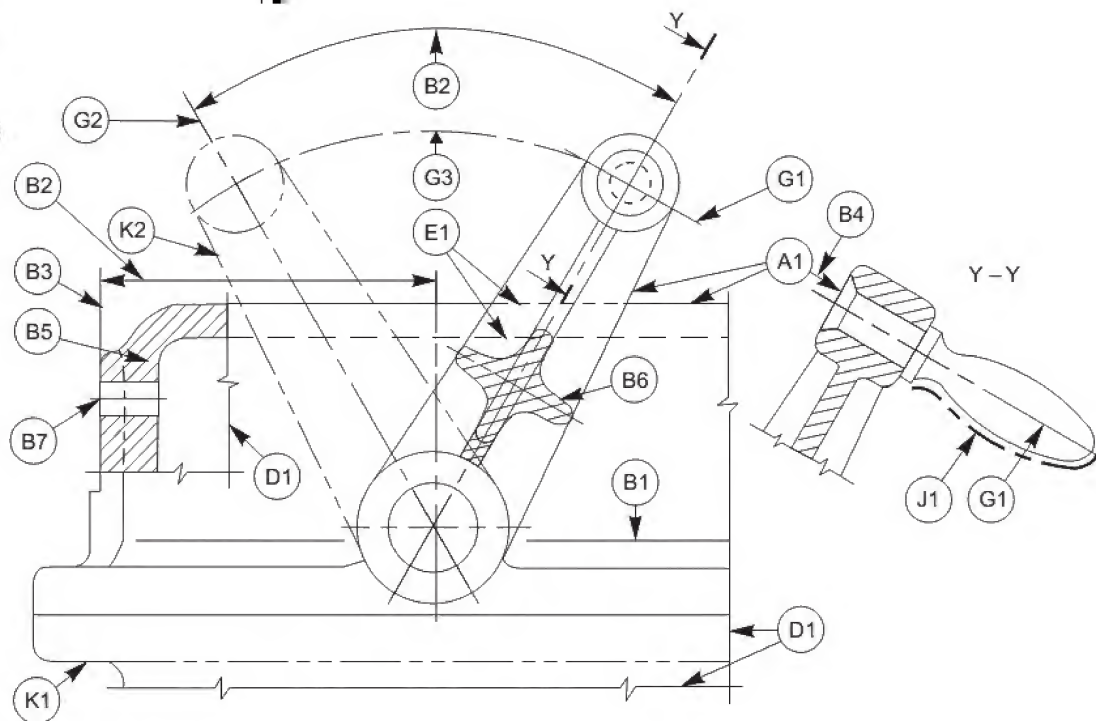
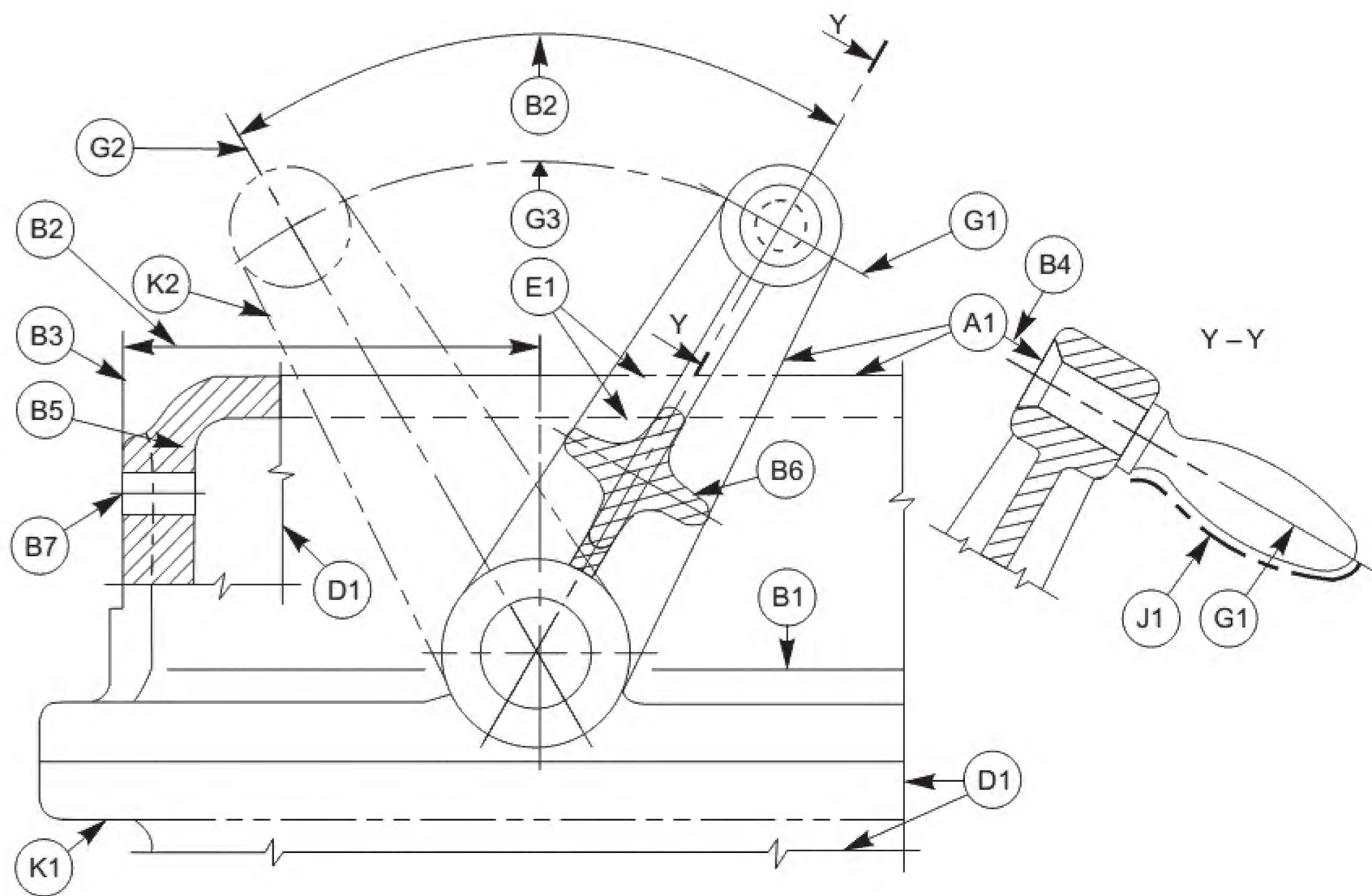


Fig. 2.4 Drawing sheet layout

<i>Line</i>	<i>General Applications</i>
A 	A1 Visible outlines
B 	B1 Imaginary lines of intersection B2 Dimension lines B3 Projection lines B4 Leader lines B5 Hatching lines B6 Outlines of revolved sections in place B7 Short centre lines
C 	C1 Limits of partial or interrupted views and sections, if the limit is not a chain thin
D 	D1 Line (see Fig. 2.5)





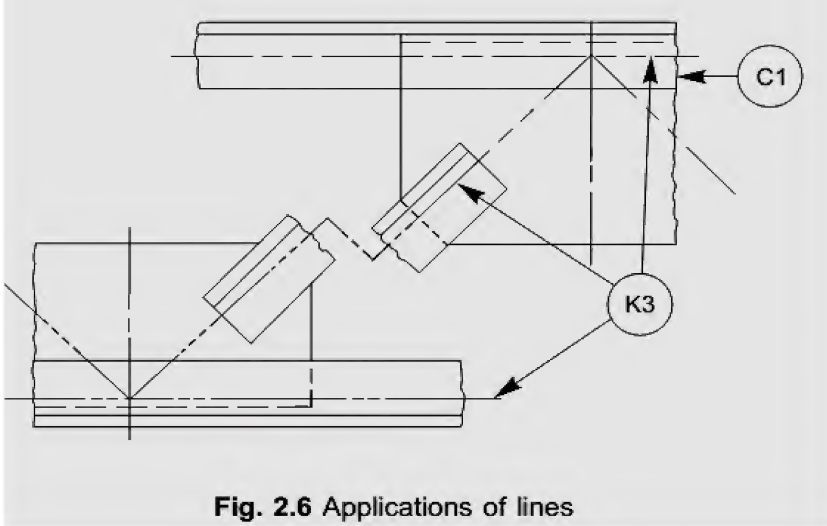
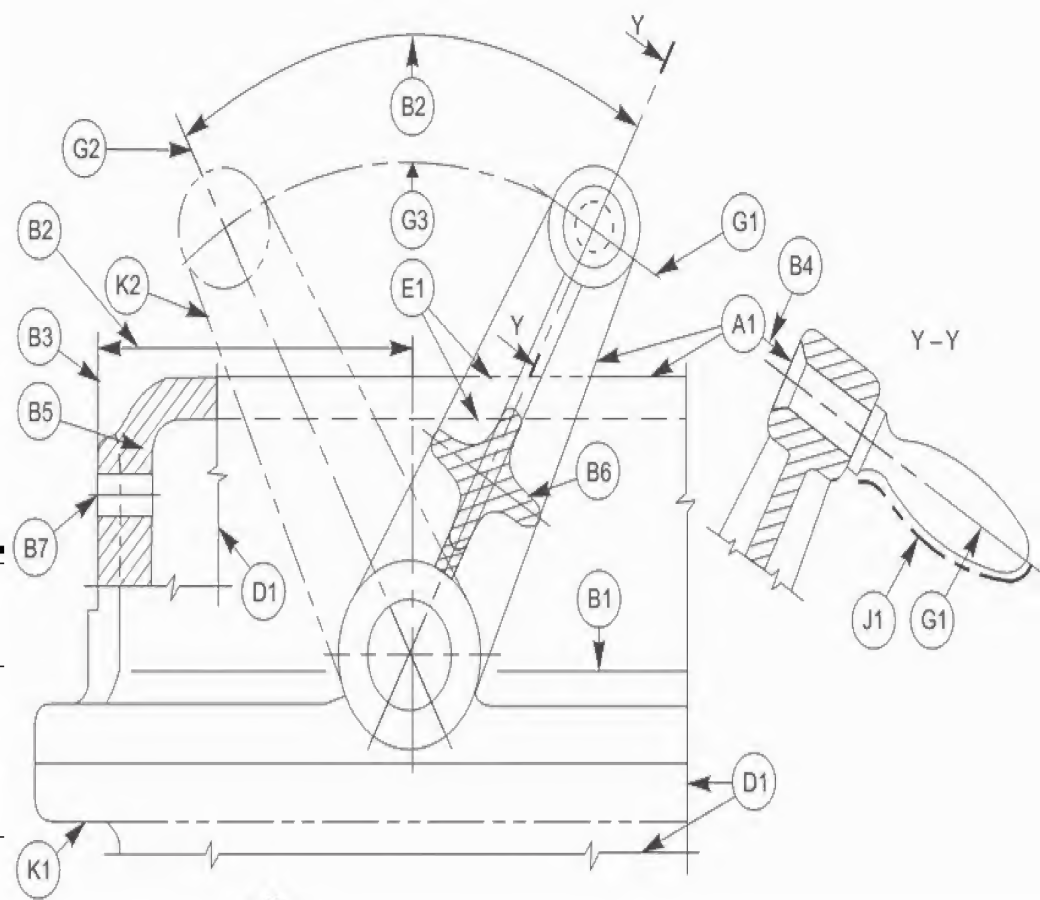


Fig. 2.6 Applications of lines



E — — — — —	E1 Hidden outlines
G — — — — —	G1 Centre lines G2 Lines of symmetry G3 Trajectories
H — — — — —	H1 Cutting planes
J — — — — —	J1 Indication of lines or surfaces to which a special requirement applies
K — — — — —	K1 Outlines of adjacent parts K2 Alternative and extreme positions of movable parts K3 Centroidal lines


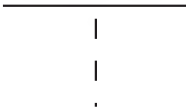
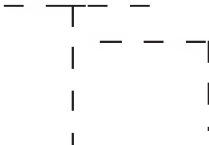
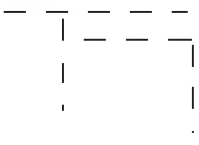

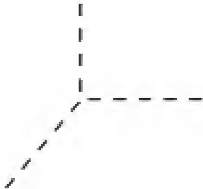
2.4.1 Thickness of Lines

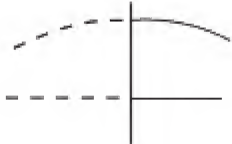
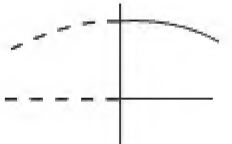

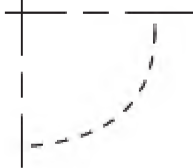
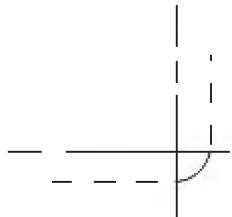
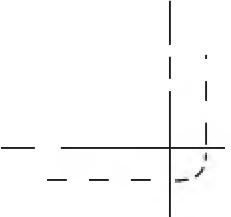
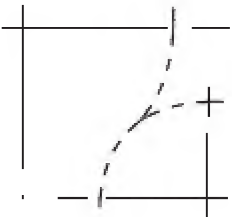
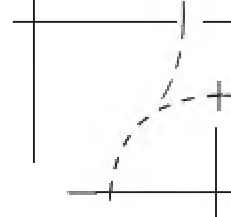
Two thicknesses of lines are used in draughting practice. The ratio of the thick to thin line should not be less than 2:1. The thickness of lines should be chosen according to the size and type of the drawing from the following range:



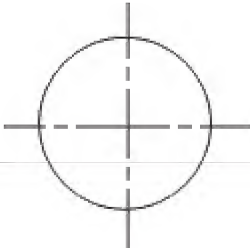
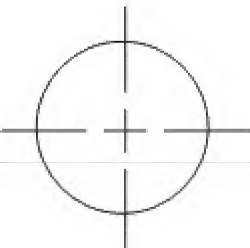
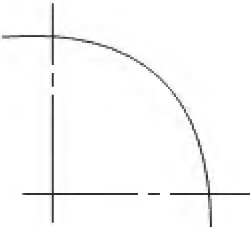
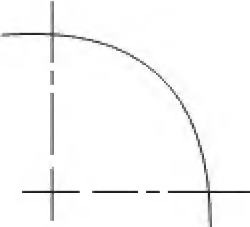
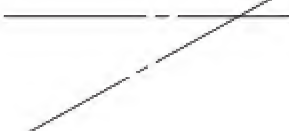



0.18, 0.25, 0.35, 0.5, 0.7, 1, 1.4 and 2

It is recommended that the space between two parallel lines, including hatching, should never be less than 0.7 mm.

Table 2.5A Invisible lines

<i>Instructions</i>	<i>Correct</i>	<i>Incorrect</i>
Begin with a dash, not with a space		
Dashes intersect without a gap between them		
Three dashes meet at the intersection point		

<i>Instructions</i>	<i>Correct</i>	<i>Incorrect</i>
As a continuation of a visible line/arc, begin with space		
Invisible arcs begin with a dash		
Small arcs may be made solid		
Two arcs meet at the point of tangency		

<i>Instructions</i>	<i>Correct</i>	<i>Incorrect</i>
Axis line starts and ends with a longer dash		
Two axes intersect with longer dashes		
		
		
		

2.5 LETTERING

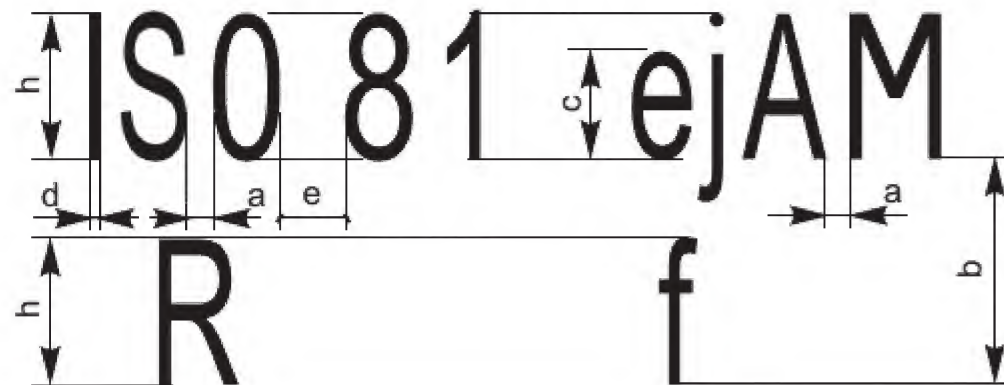
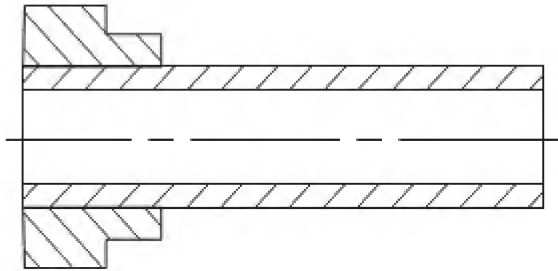


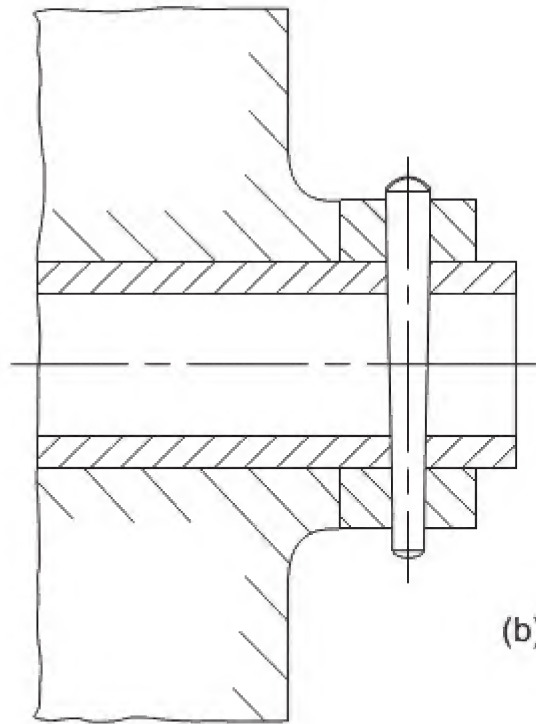
Table 2.6 Lettering A ($d = h/14$)

<i>Characteristic</i>	<i>Ratio</i>	<i>Dimensions, (mm)</i>							
Lettering height (Height of capitals)	h (14/14) h	2.5	3.5	5	7	10	14	20	
Height of lower-case letters (without stem or tail)	c (10/14) h	—	2.5	3.5	5	7	10	14	
Spacing between characters	a (2/14) h	0.35	0.5	0.7	1	1.4	2	2.8	
Minimum spacing of base lines	b (20/14) h	3.5	5	7	10	14	20	28	
Minimum spacing between words	e (6/14) h	1.05	1.5	2.1	3	4.2	6	8.4	
Thickness of lines	d (1/14) h	0.18	0.25	0.35	0.5	0.7	1	1.4	

2.6.1 Hatching of Sections



(a)



(b)

Fig. 2.12 Hatching of adjacent components

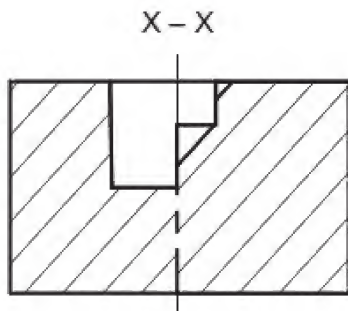


Fig. 2.13 Sectioning along two parallel planes

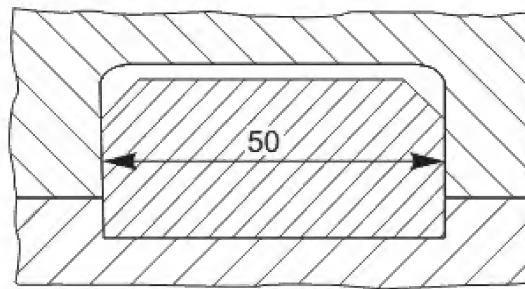
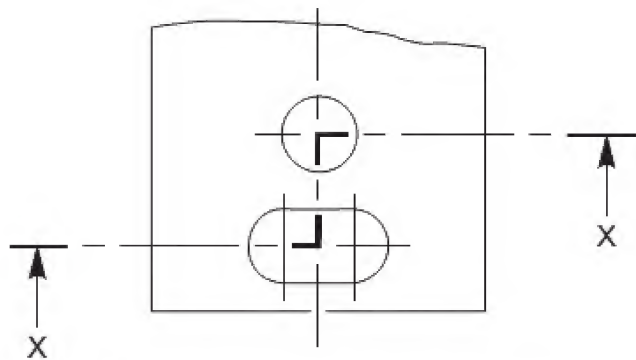


Fig. 2.14 Hatching interrupted for dimensioning

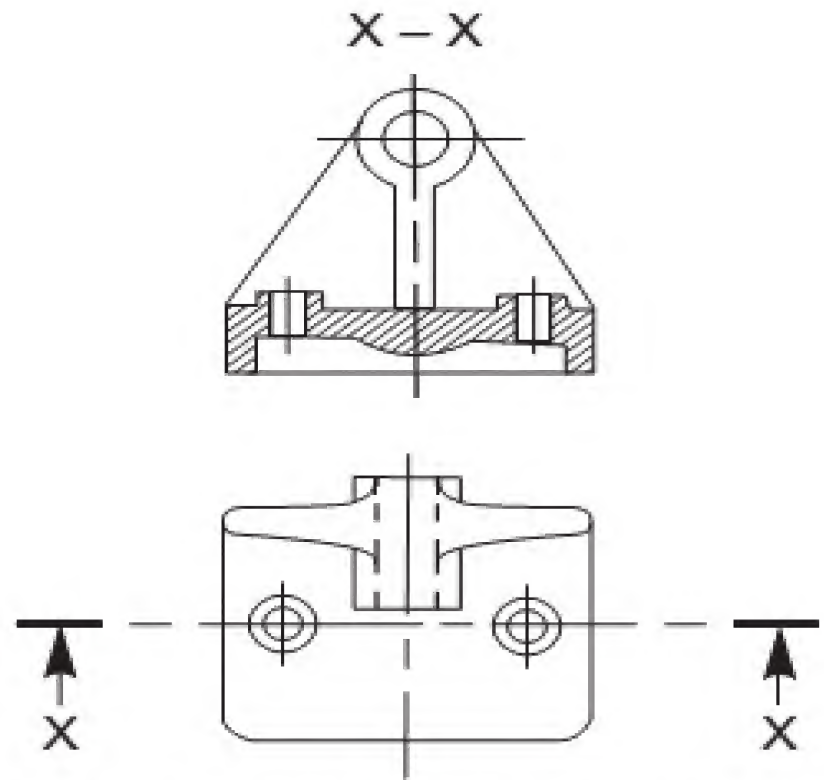
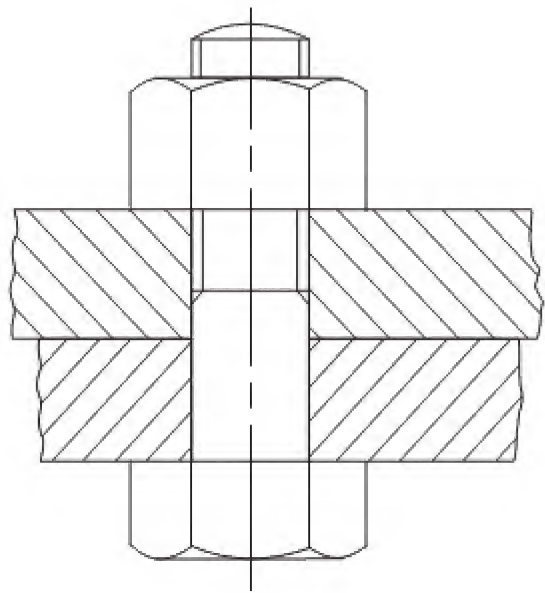
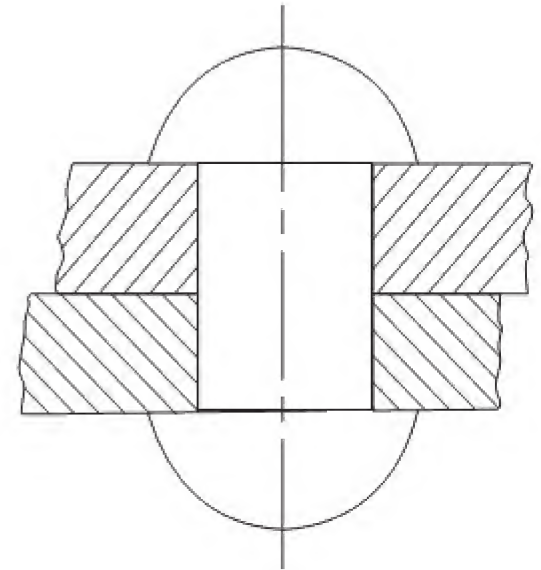
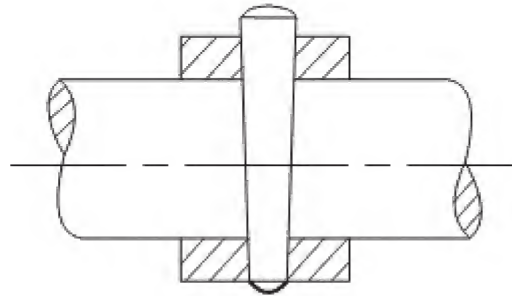


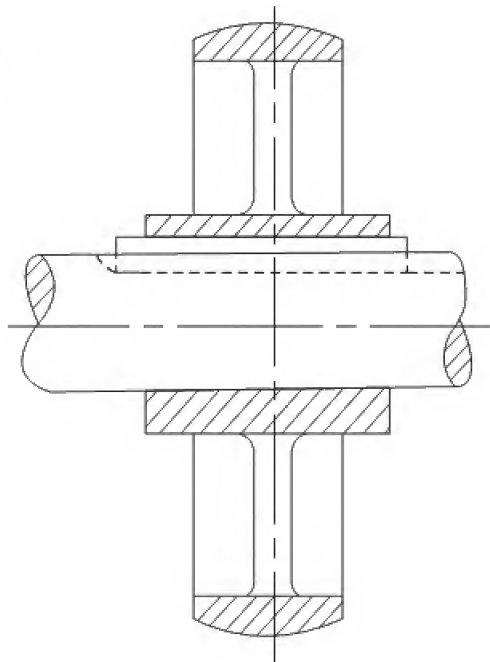
Fig. 2.15 Cutting plane indication



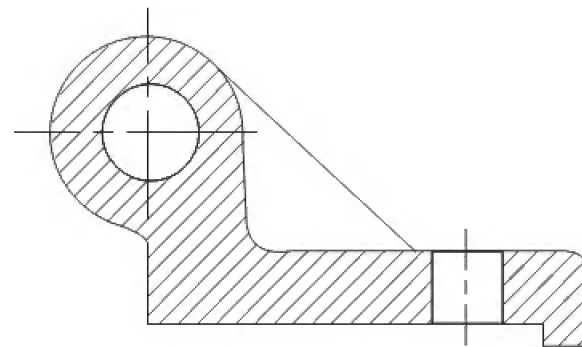
(a)



(c)



(d)



(e)

Fig. 2.16 Sections not to be hatched

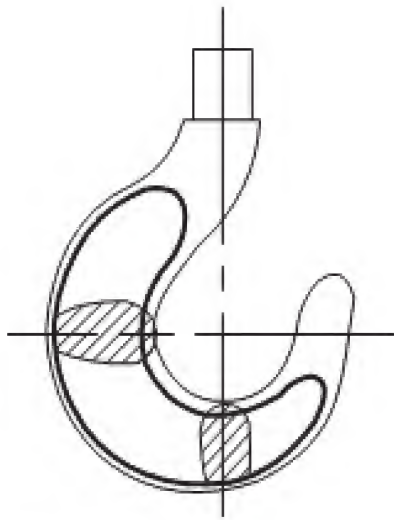


Fig. 2.21 Revolved section

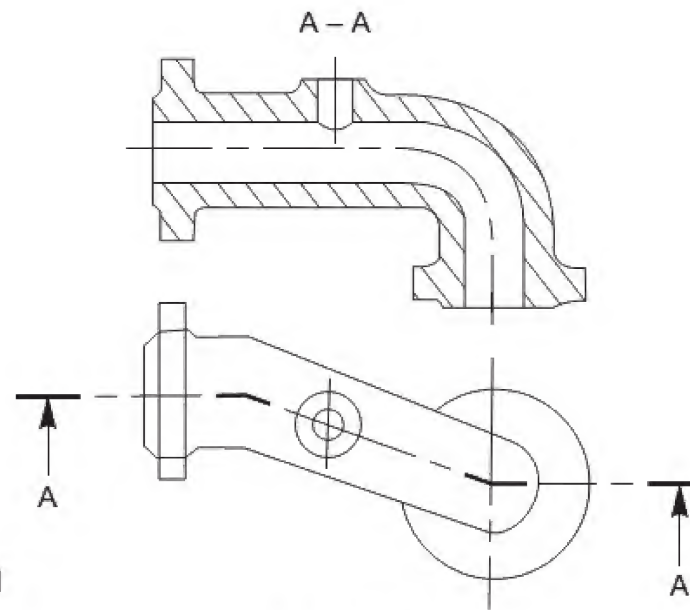


Fig. 2.17

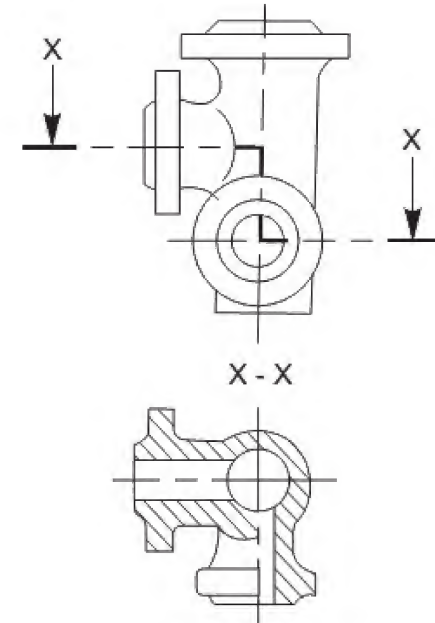


Fig. 2.18

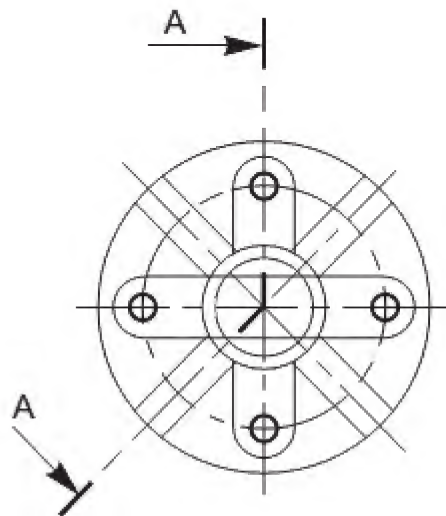


Fig. 2.19

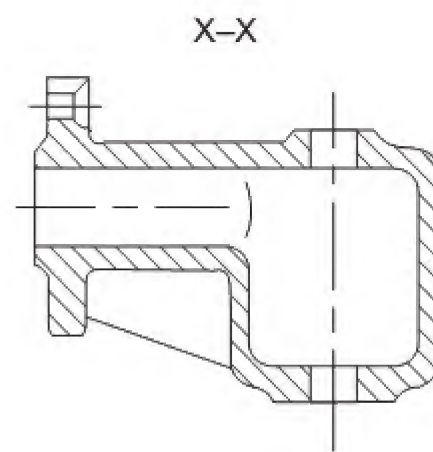
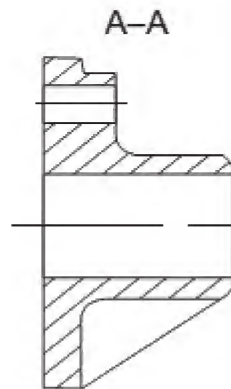
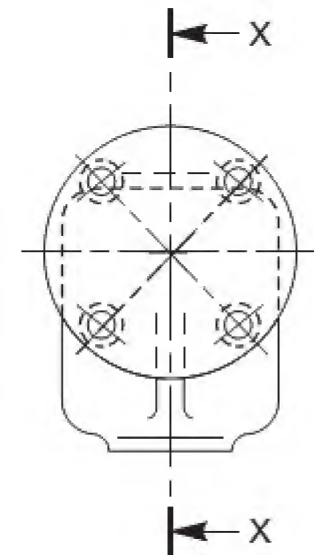


Fig. 2.20



2.6.4 Half Section

Symmetrical parts may be drawn, half in plain view and half in section (Fig 2.23).

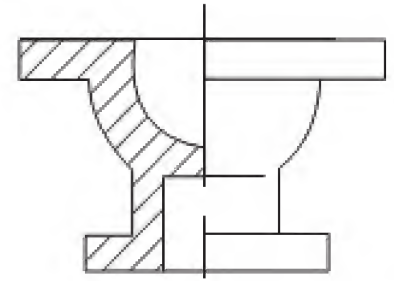


Fig. 2.23 Half section

2.6.5 Local Section

A local section may be drawn if half or full section is not convenient. The local break may be shown by a continuous thin free hand line (Fig. 2.24).

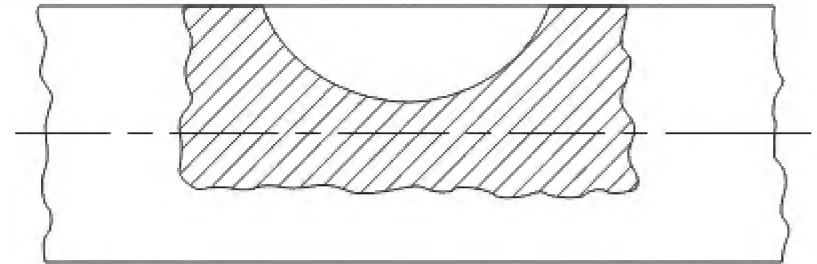


Fig. 2.24 Local section

2.6.6 Arrangement of Successive Sections

Successive sections may be placed separately, with designations for both cutting planes and sections (Fig. 2.25) or may be arranged below the cutting planes.

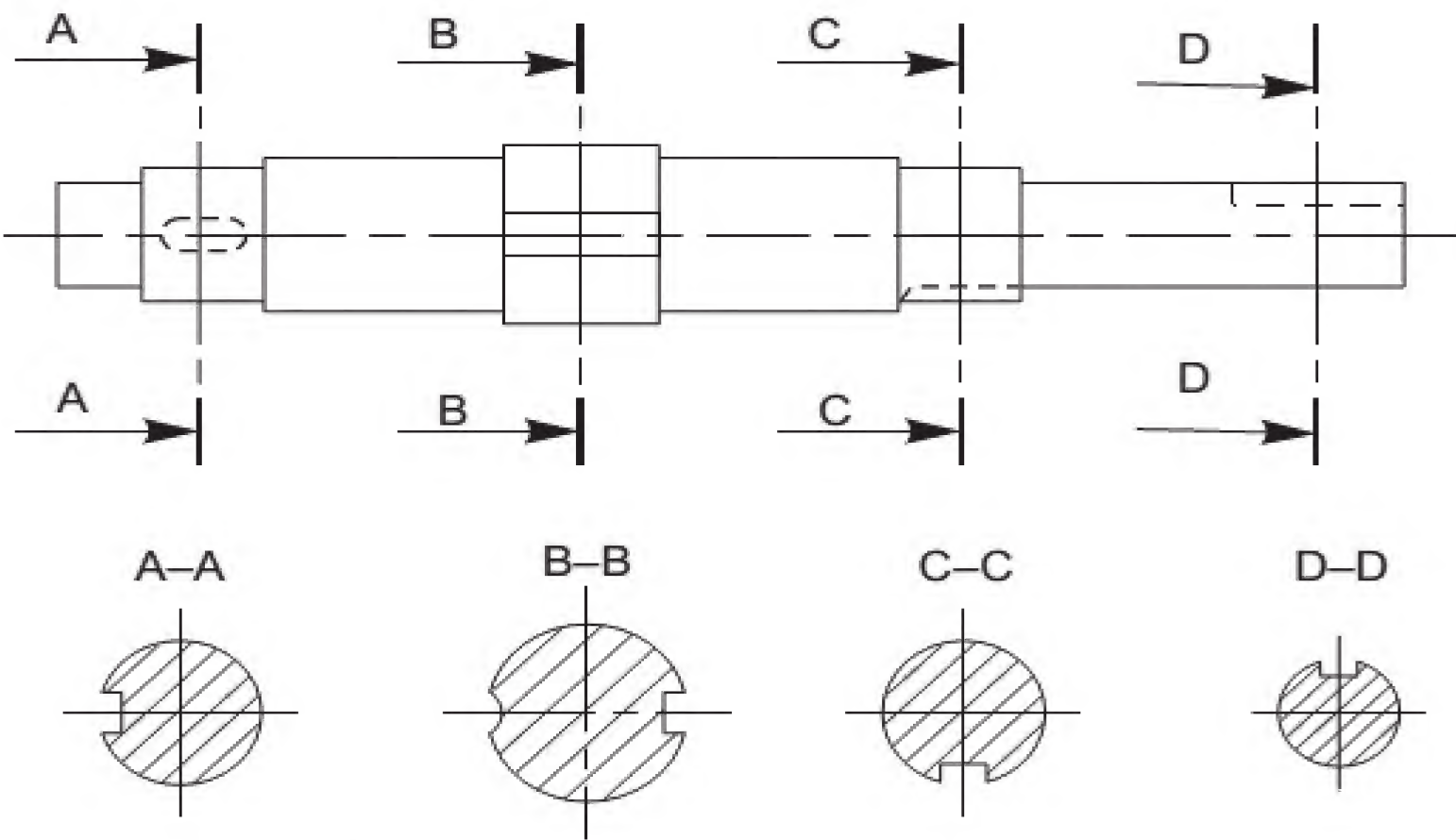
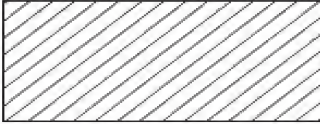
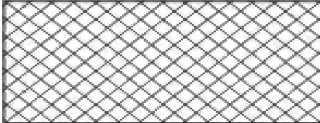


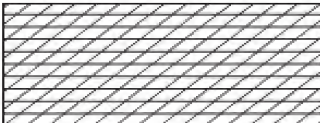
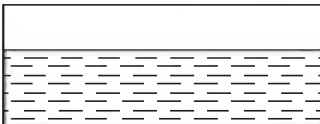

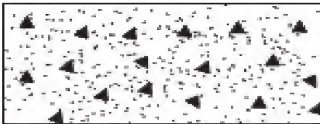

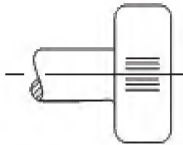
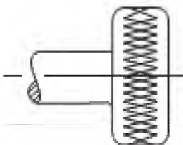
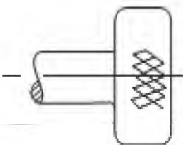
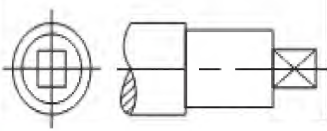
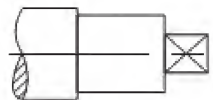
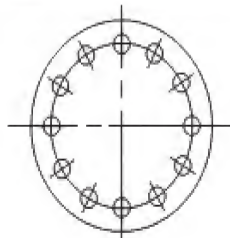
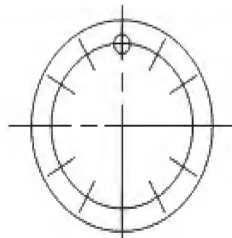
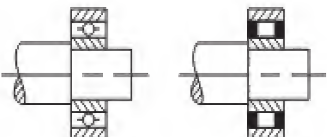
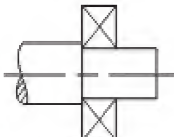
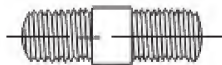
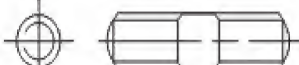
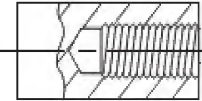
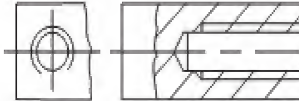
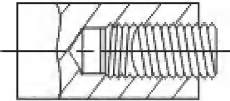
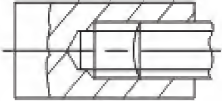


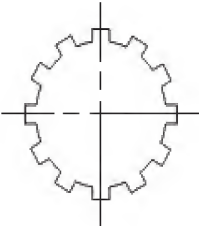
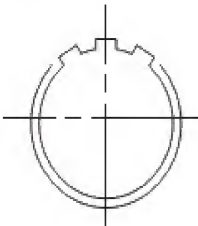
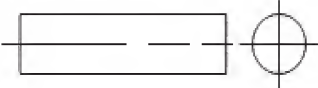
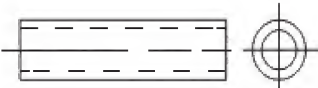
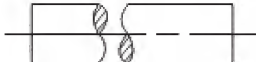
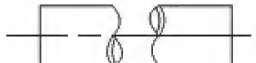
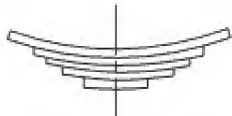

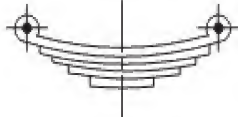
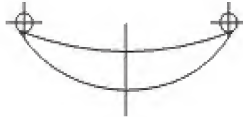
Fig. 2.25 Successive sections

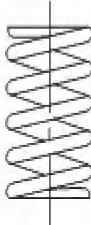





Type	Convention	Material
Metals		Steel, Cast Iron, Copper and its Alloys, Aluminium and its Alloys, etc.
		Lead, Zinc, Tin, White-metal, etc.
Glass		Glass
Packing and Insulating material		Porcelain, Stoneware, Marble, Slate, etc.
		Asbestos, Fibre, Felt, Synthetic resin products, Paper, Cork, Linoleum, Rubber, Leather, Wax, Insulating and Filling materials, etc.
Liquids		Water, Oil, Petrol, Kerosene, etc.
Wood		Wood, Plywood, etc.
Concrete		A mixture of Cement, Sand and Gravel

Title	Subject	Convention
Straight knurling		
Diamond knurling		
Square on shaft		
Holes on circular pitch		
Bearings		

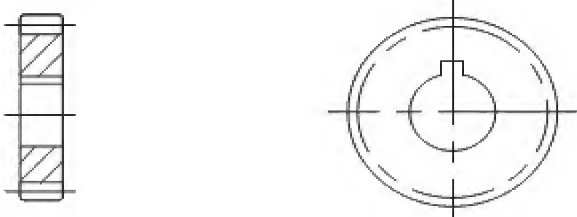
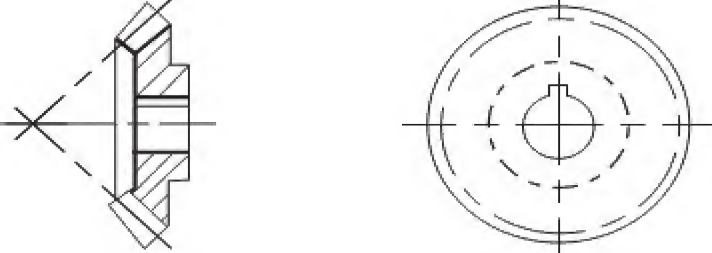
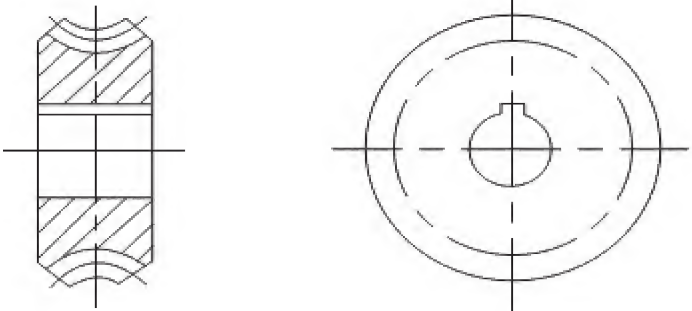

External screw threads (Detail)		
Internal screw threads (Detail)		
Screw threads (Assembly)		

(a)

Title	Subject		Convention
Splined shafts			
Interrupted views	 		 
Semi-elliptic leaf spring			
Semi-elliptic leaf spring with eyes			
	Subject	Convention	Diagrammatic Representation

Cylindrical compression spring			
Cylindrical tension spring			

(b)

Title	Convention
Spur gear	 <p>The cross-section view on the left shows a gear with two hatched regions representing the teeth. The front view on the right shows a circular gear with a central hub, with concentric dashed circles representing the addendum and dedendum.</p>
Bevel gear	 <p>The cross-section view on the left shows a bevel gear with a conical shape and hatched teeth. The front view on the right shows a circular gear with a central hub and concentric dashed circles.</p>
Worm wheel	 <p>The cross-section view on the left shows a worm wheel with a cylindrical shape and hatched teeth. The front view on the right shows a circular gear with a central hub and concentric dashed circles.</p>
Worm	 <p>The side view on the left shows a worm with a cylindrical shape and horizontal lines representing the teeth. The front view on the right shows a circular gear with a central hub and concentric dashed circles.</p>

2.8.4 Methods of Indicating Dimensions

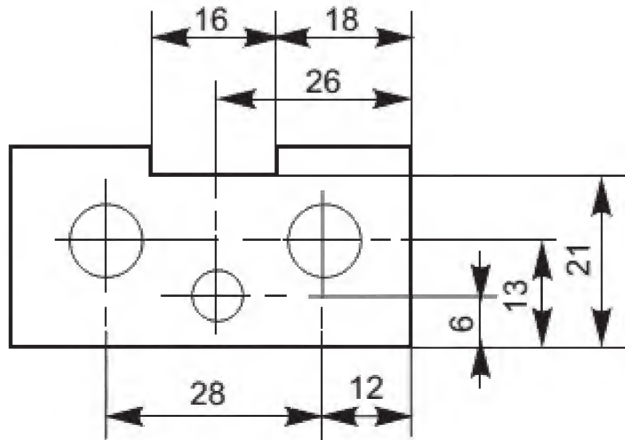


Fig. 2.31

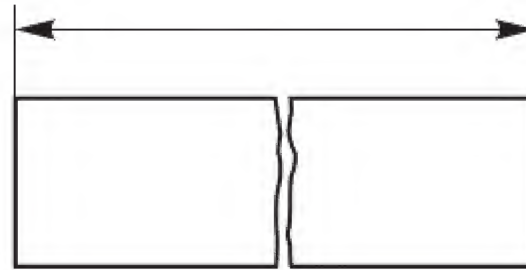


Fig. 2.32

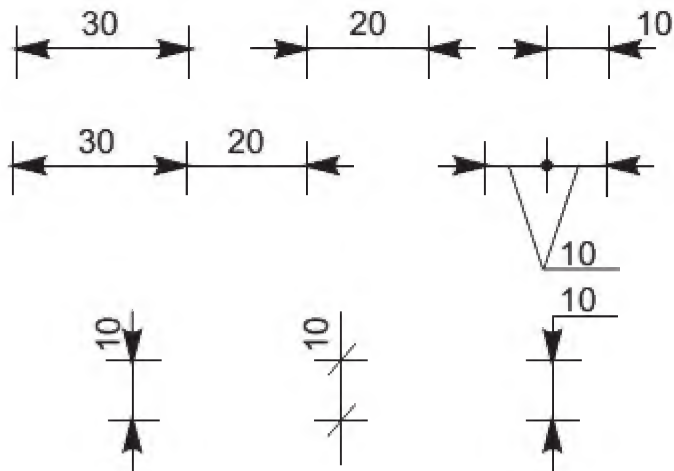


Fig. 2.34

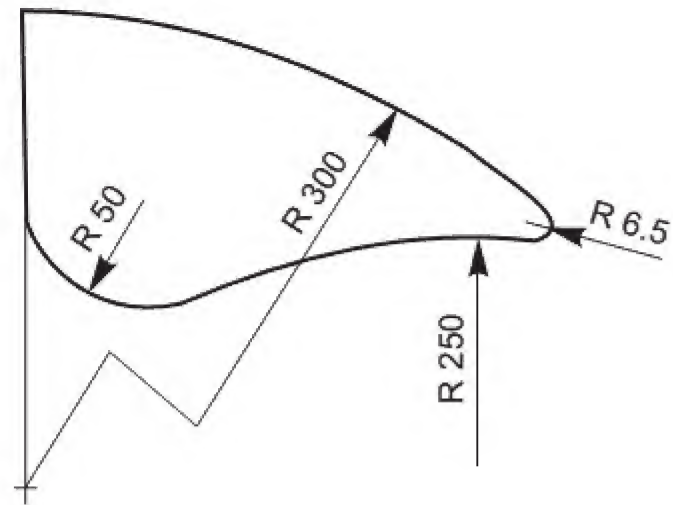


Fig. 2.35

METHOD-1 (Aligned System)

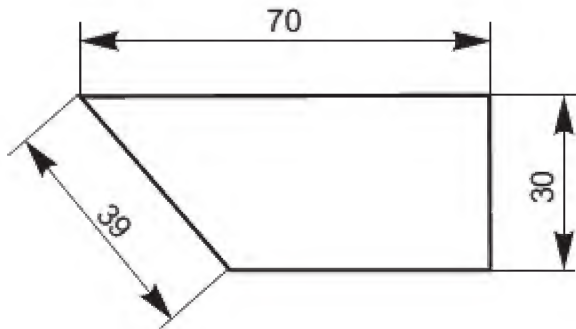


Fig. 2.36

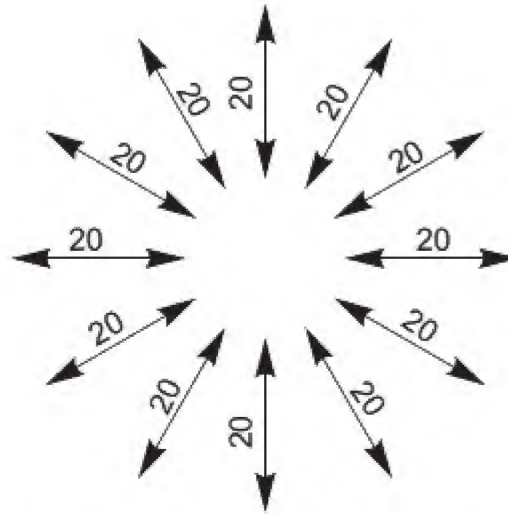


Fig. 2.37 Oblique dimensioning

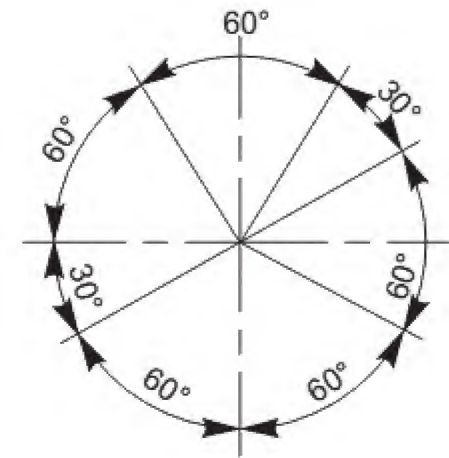


Fig. 2.38 Angular dimensioning

METHOD-2 (Uni-directional System)

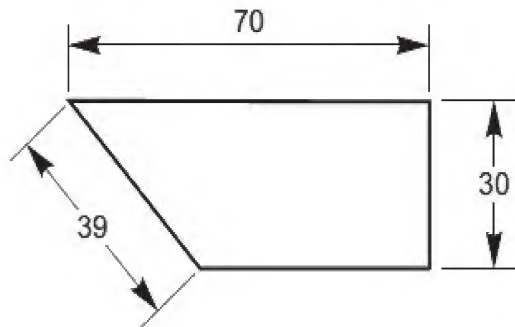


Fig. 2.39

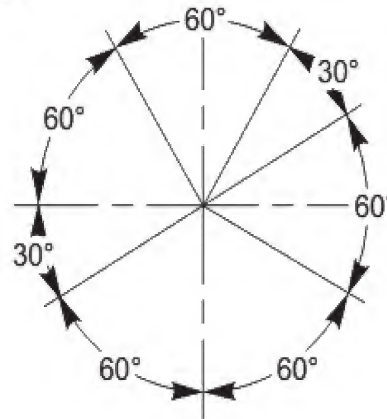


Fig. 2.40 Angular dimensioning

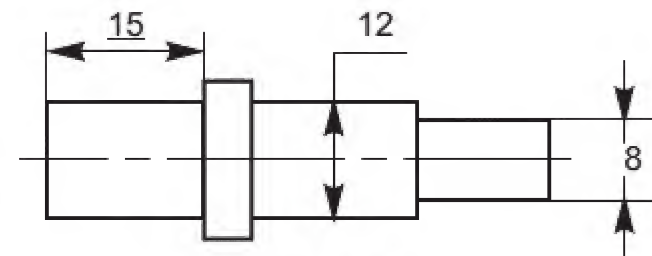


Fig. 2.41

ϕ : Diameter $S\phi$: Spherical diameter R : Radius SR : Spherical radius \square : Square

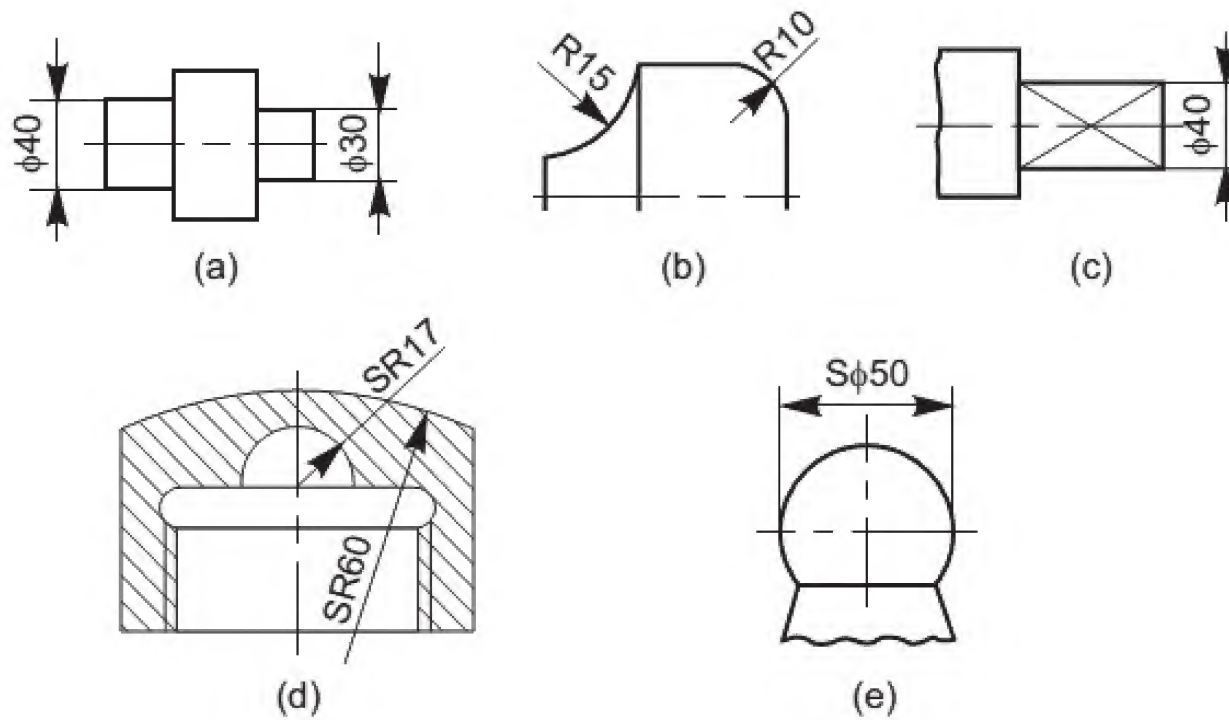


Fig. 2.42 Shape identification symbols

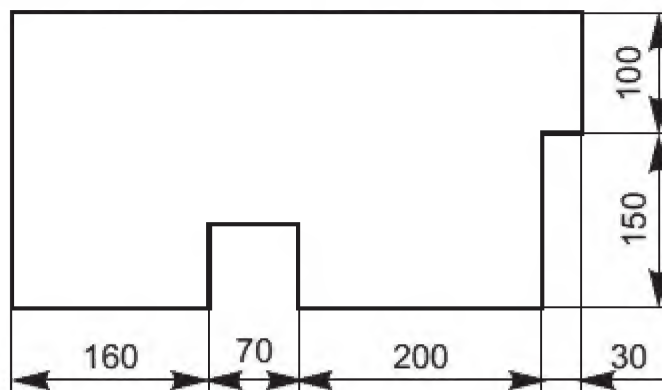
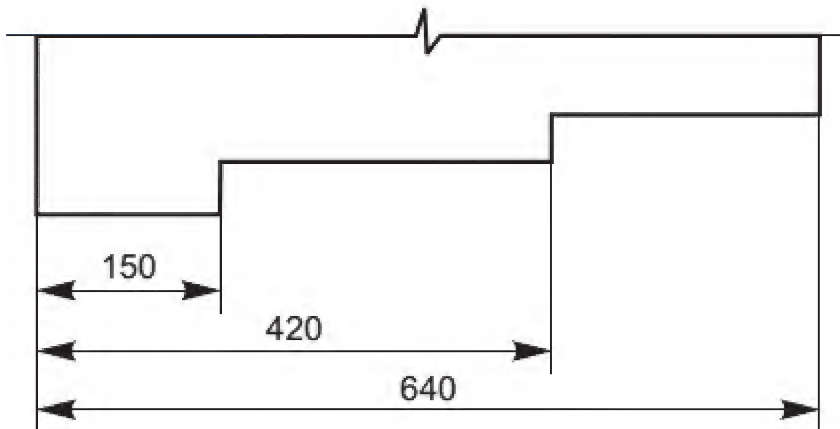


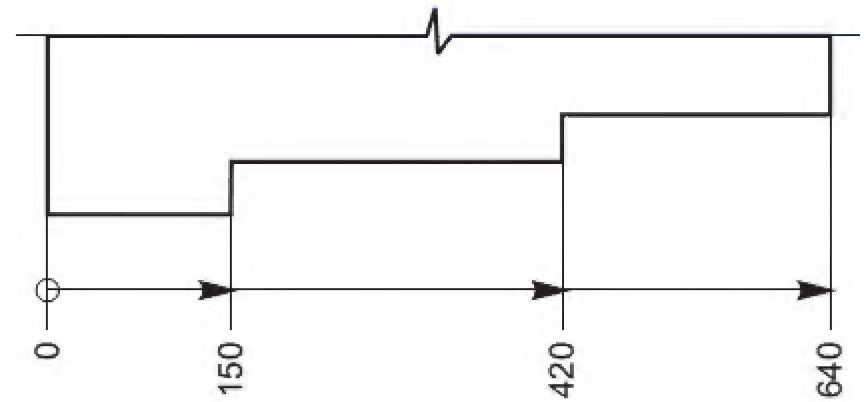
Fig. 2.43 Chain dimensioning

2.8.5.3 Super-imposed Running Dimensions

These are simplified parallel dimensions and may be used where there are space limitations ([Fig. 2.44 b](#)).



(a)



(b)

Fig. 2.44 Parallel dimensioning

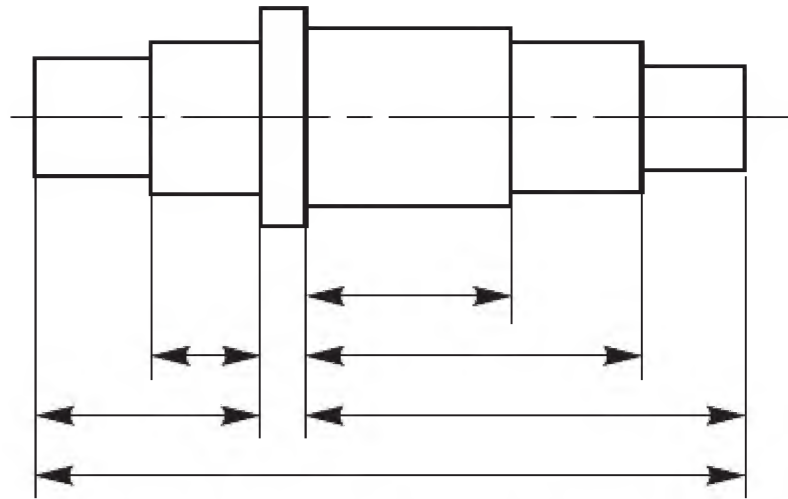


Fig. 2.45 Combined dimensioning

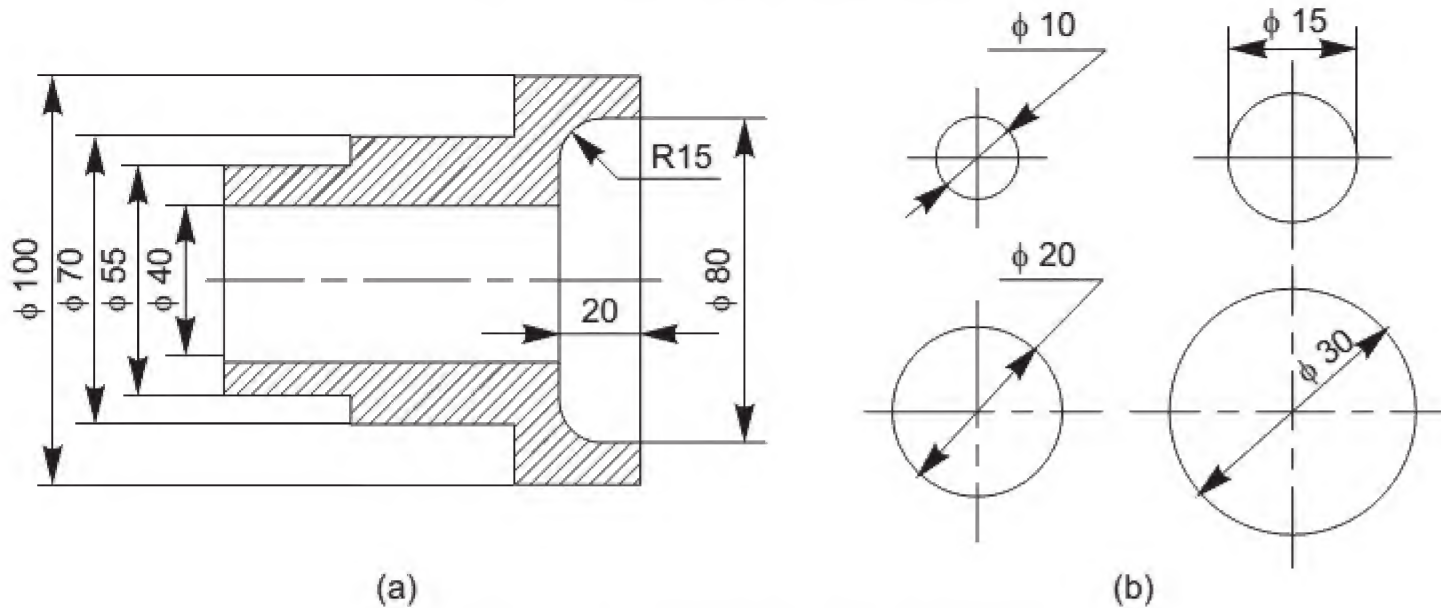


Fig. 2.47 Dimensioning of diameters

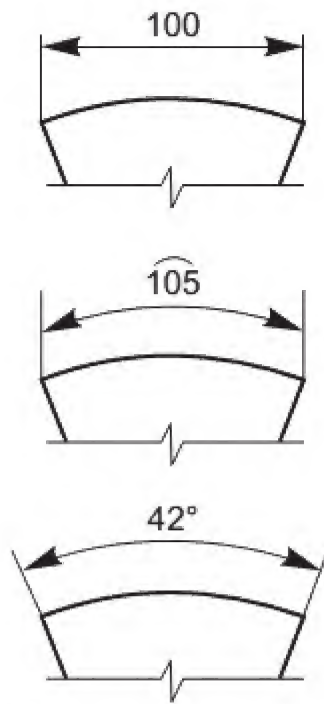


Fig. 2.48 Dimensioning of chords, arcs and angles

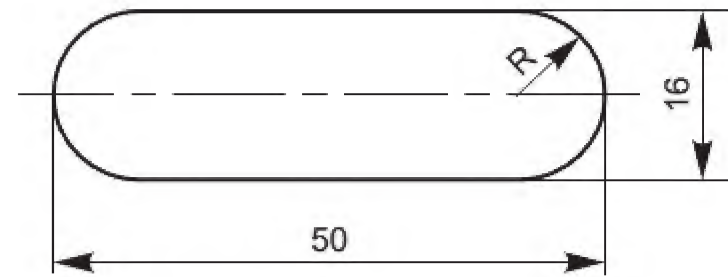


Fig. 2.49 Dimensioning of radius

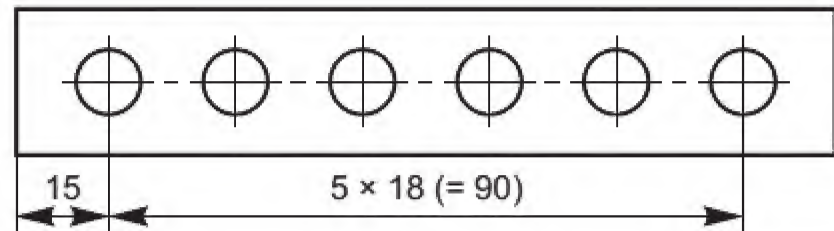


Fig. 2.50 Dimensioning equi-distant features

2.8.6.4 Chamfers and Countersunks

Chamfers may be dimensioned as shown in Fig. 2.51 and countersunks, as shown in Fig. 2.52.

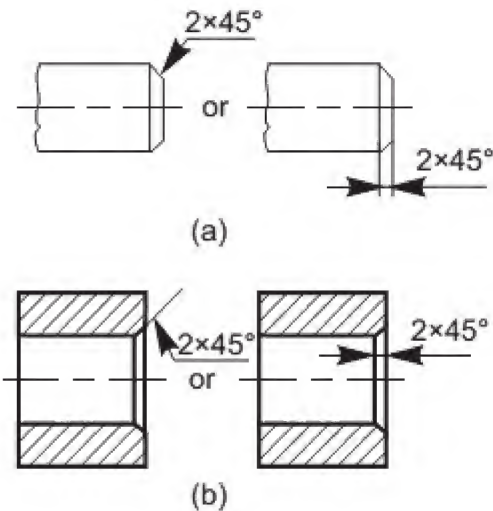


Fig. 2.51 Dimensioning chamfers

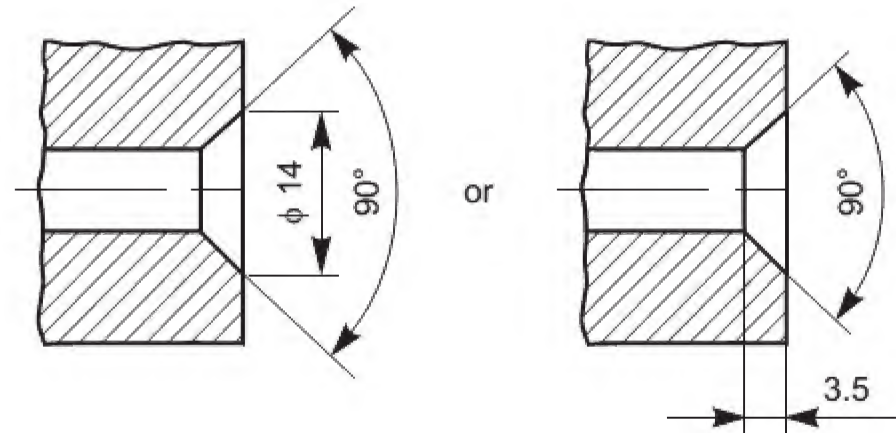


Fig. 2.52 Dimensioning countersunks

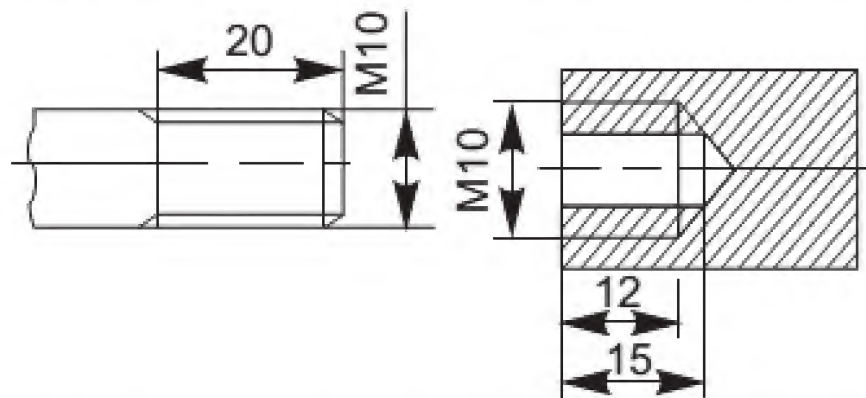


Fig. 2.53 Dimensioning screw threads

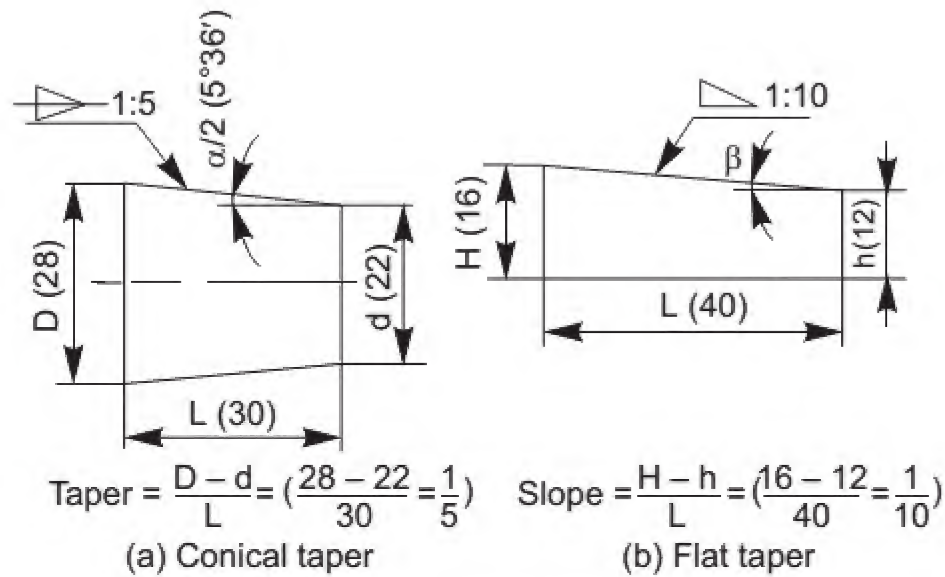


Fig. 2.54 Dimensioning tapered features

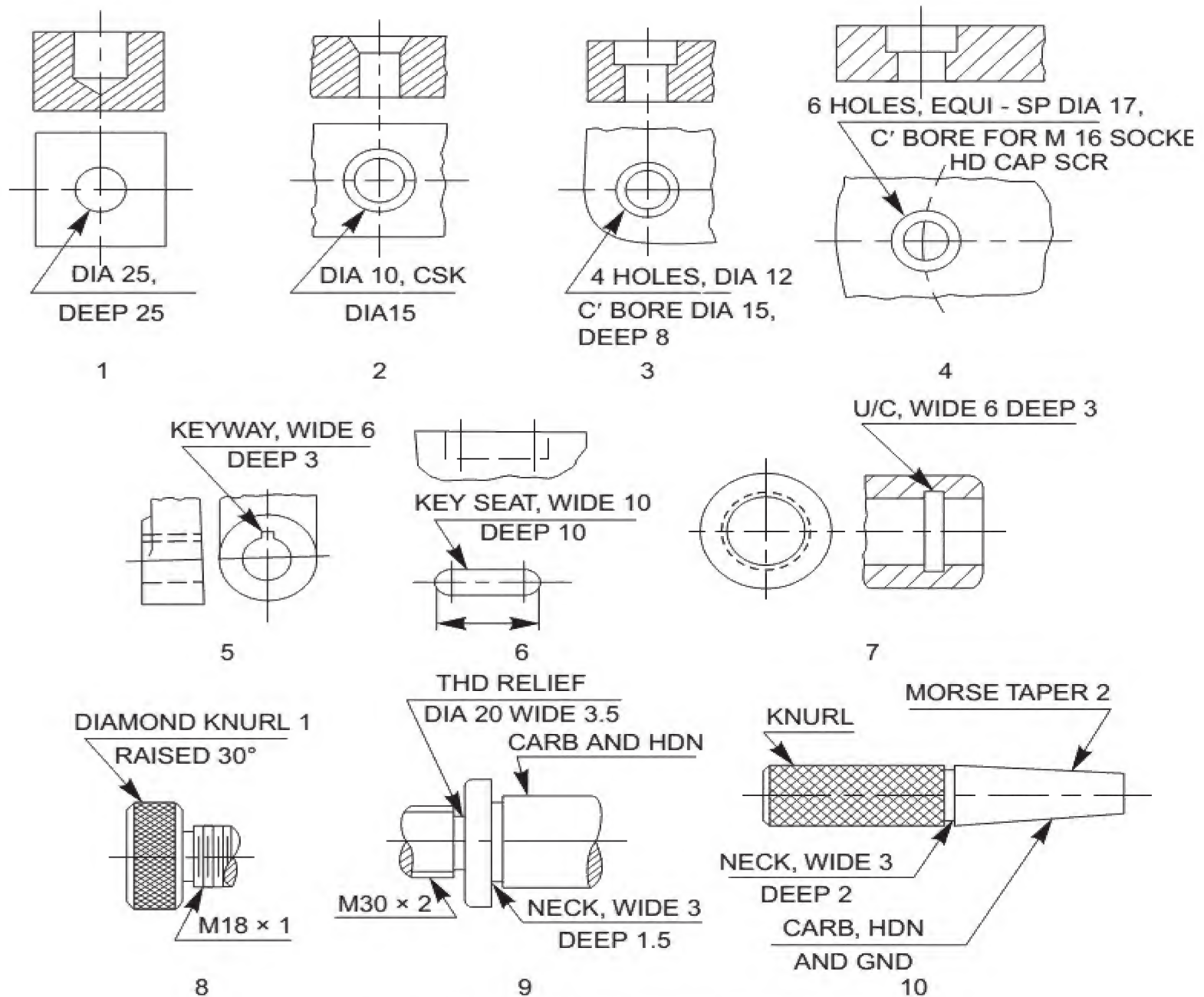
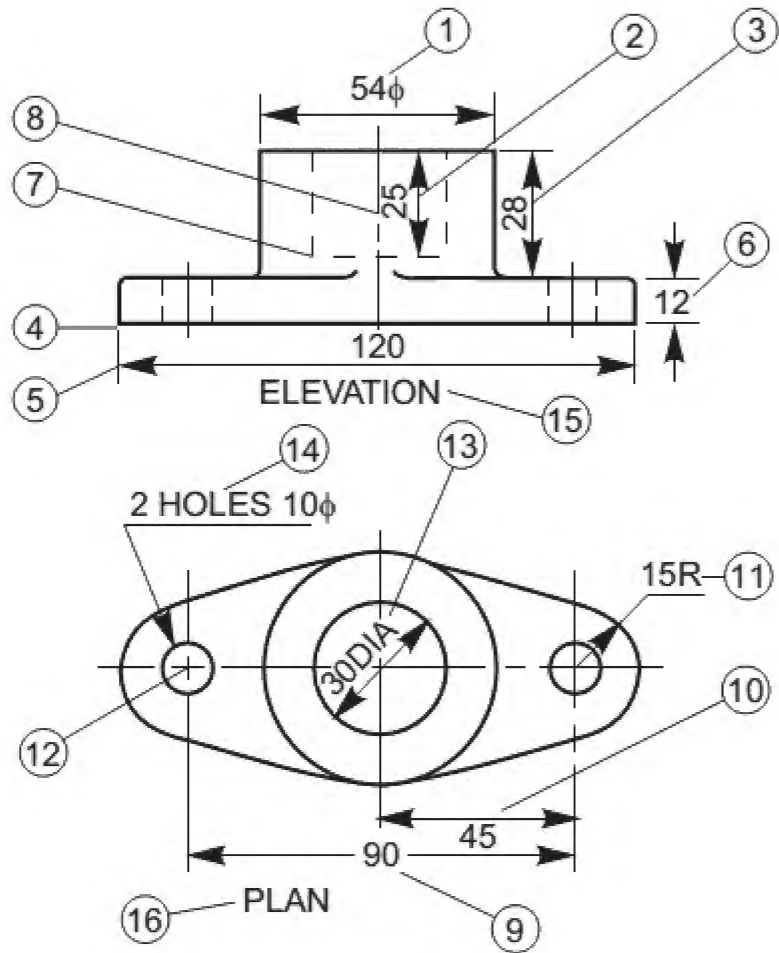
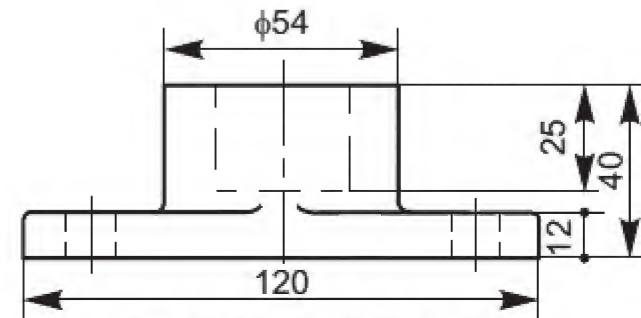


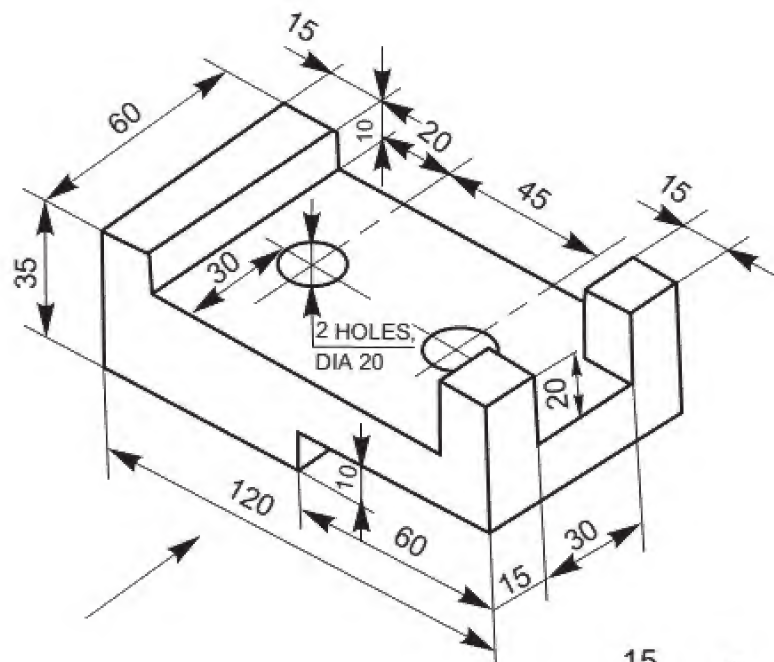
Fig. 2.55 Method of indicating notes (*Contd.*)



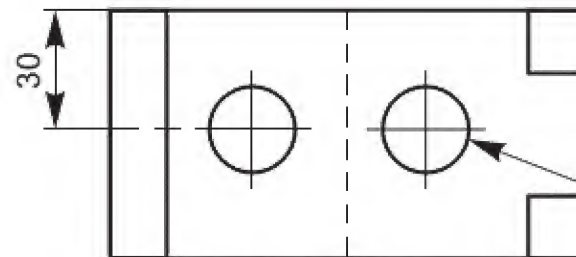
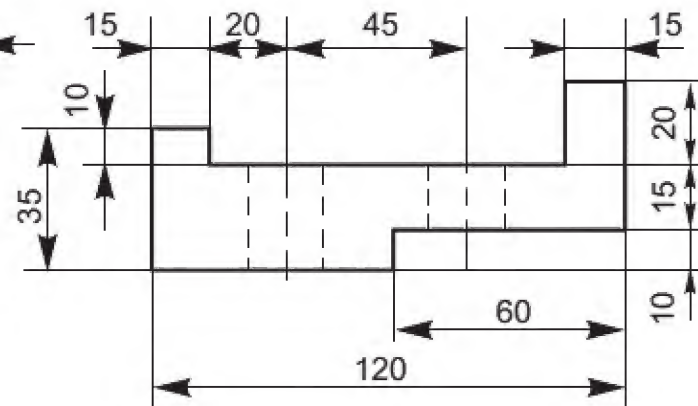
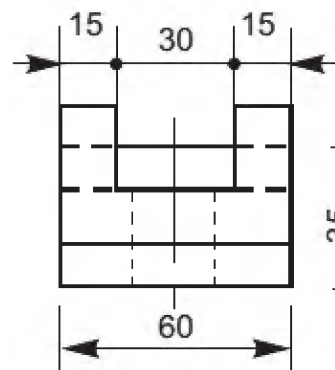
a-Incorrect



b-Correct

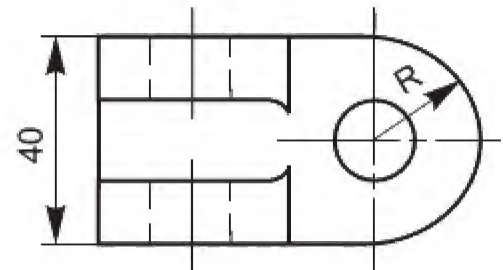
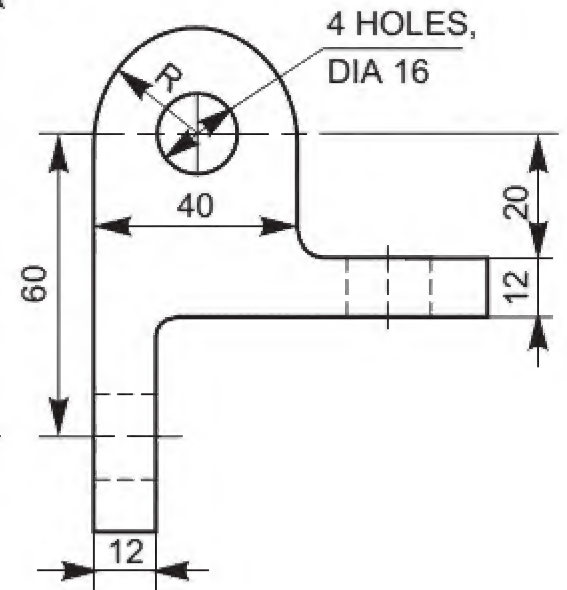
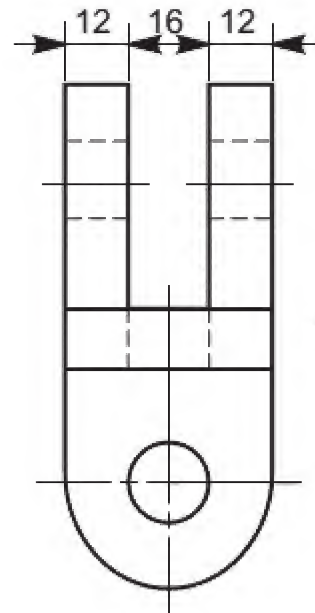
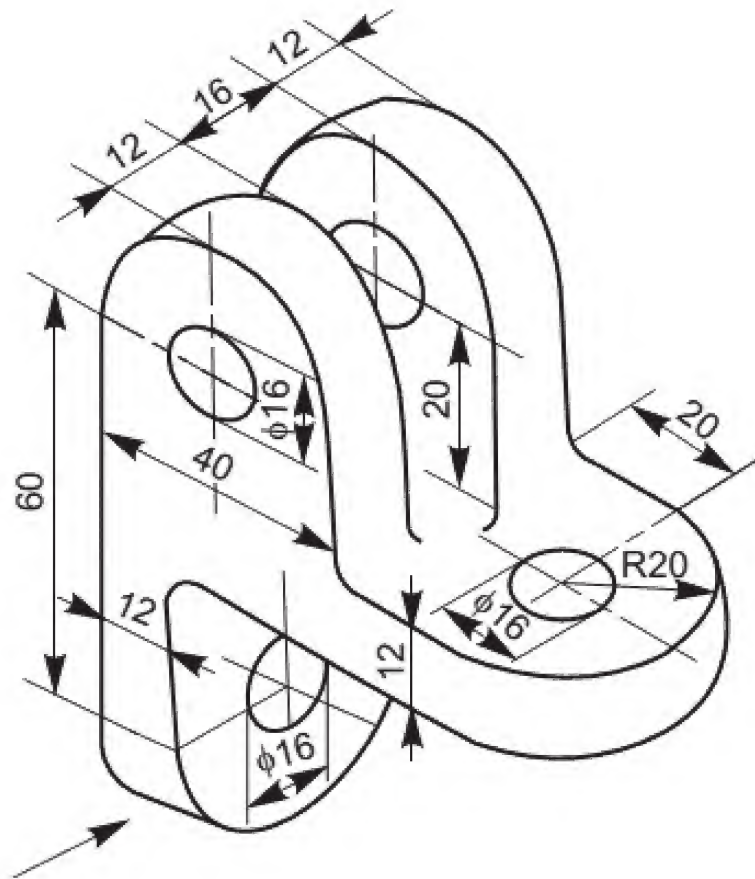


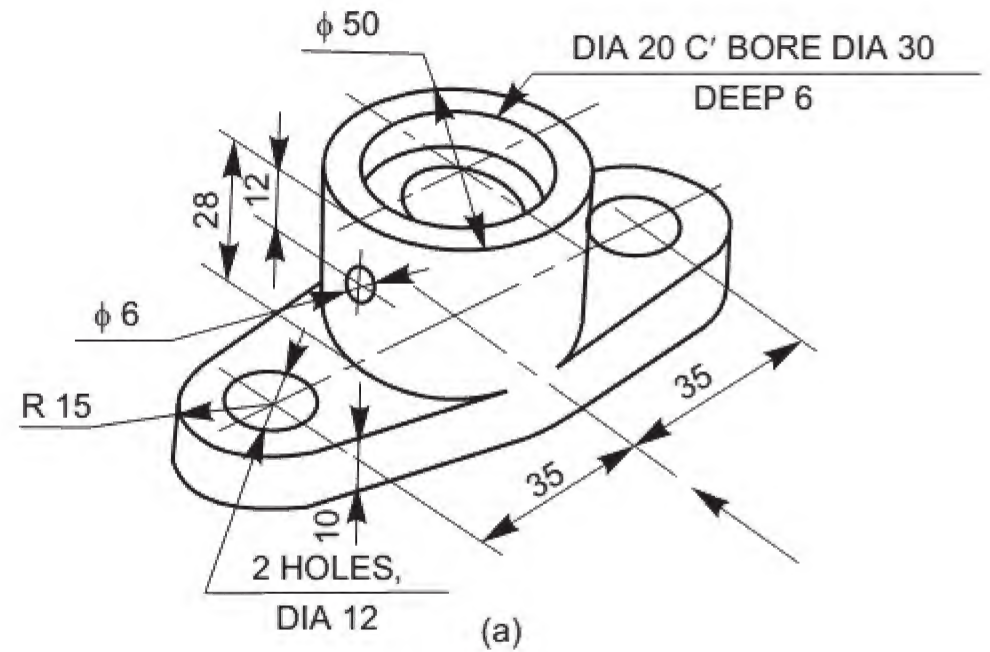
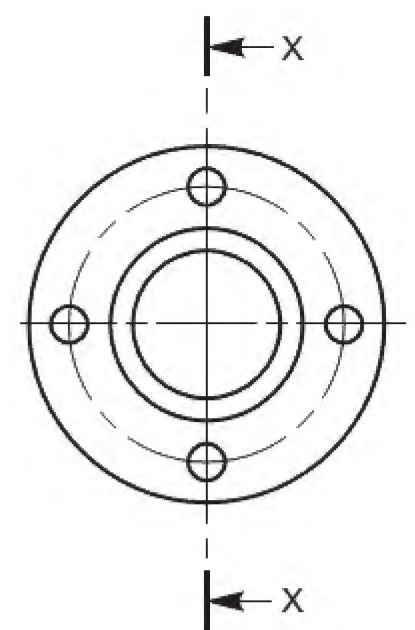
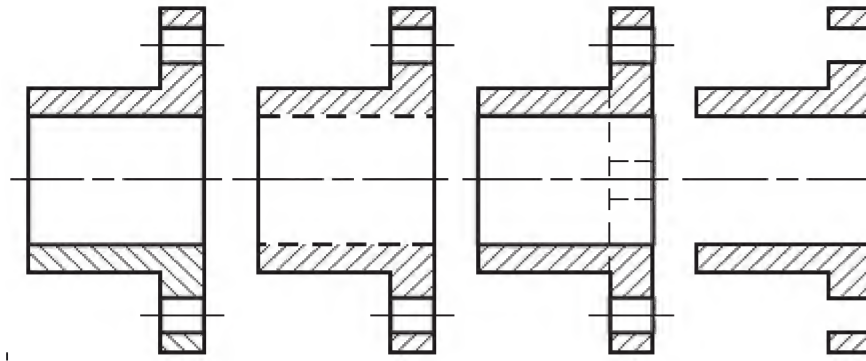
(a)

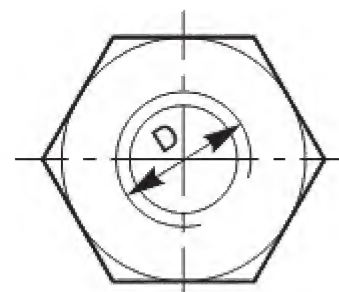
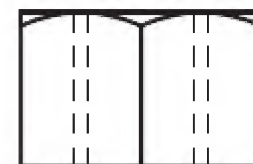
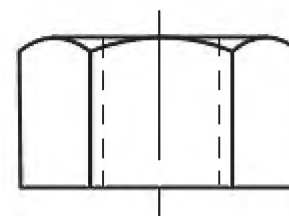
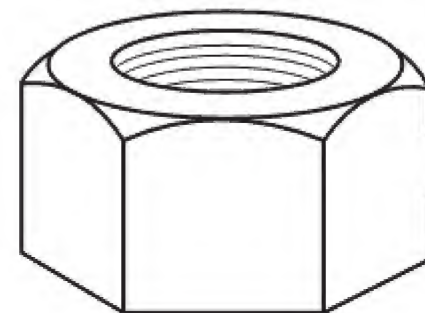
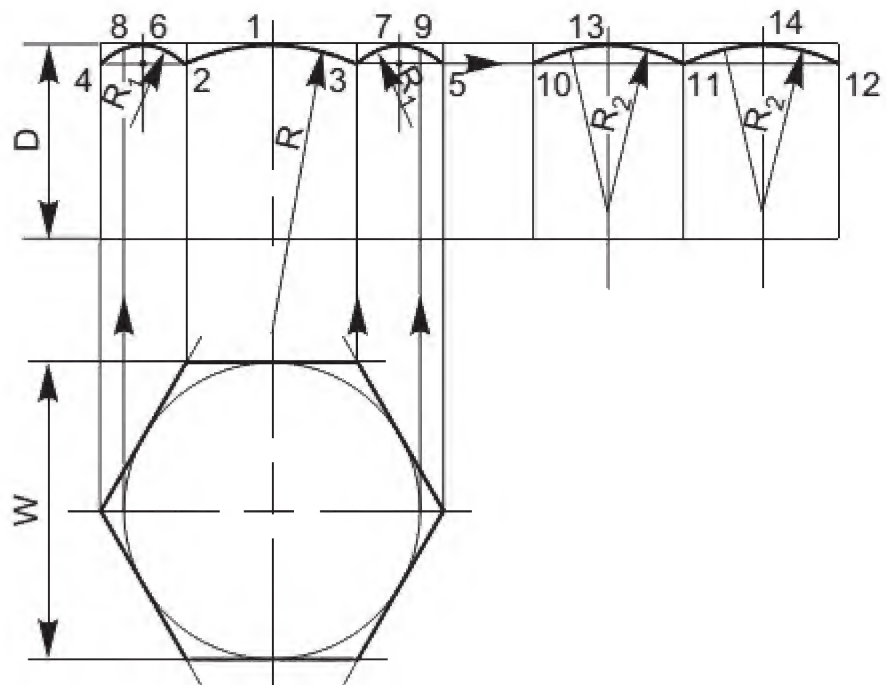


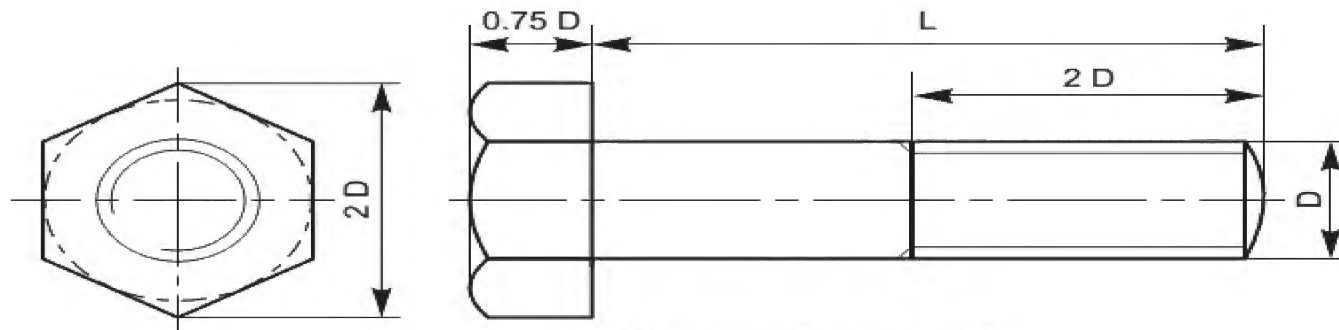
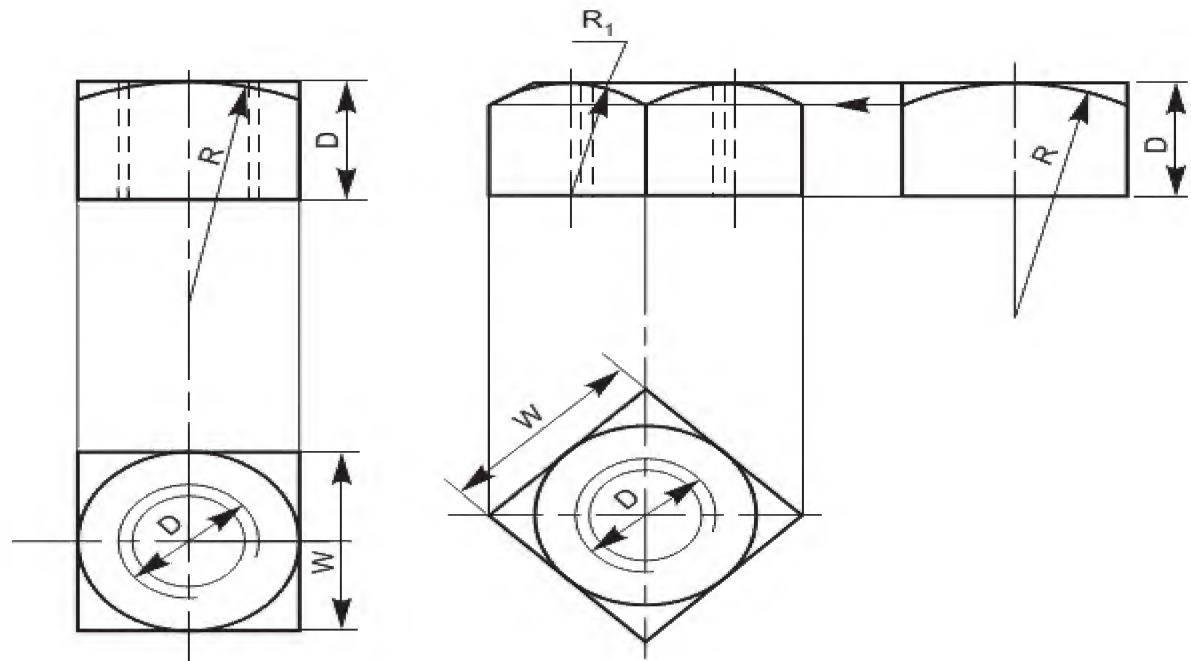
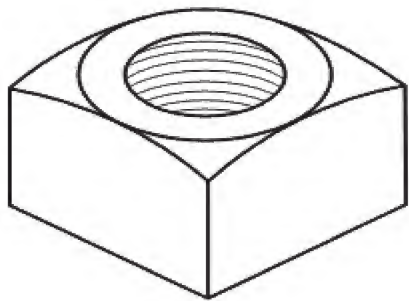
2 HOLES,
DIA 20

(b)

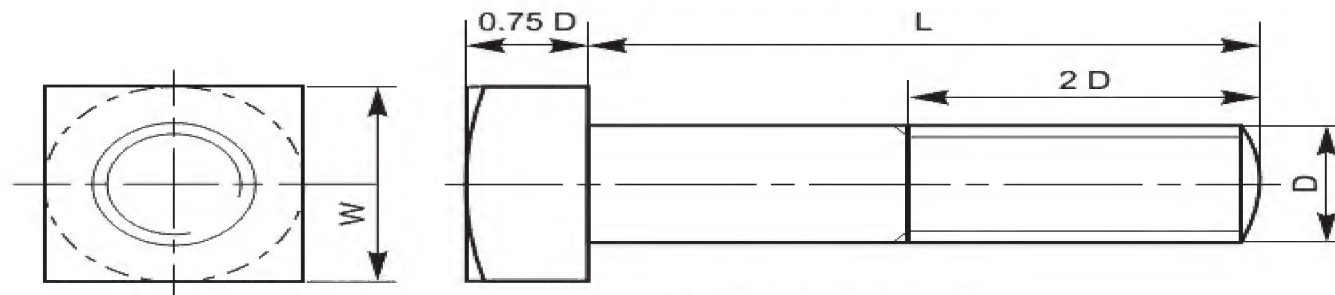








(a) Hexagonal headed bolt



(b) Square headed bolt

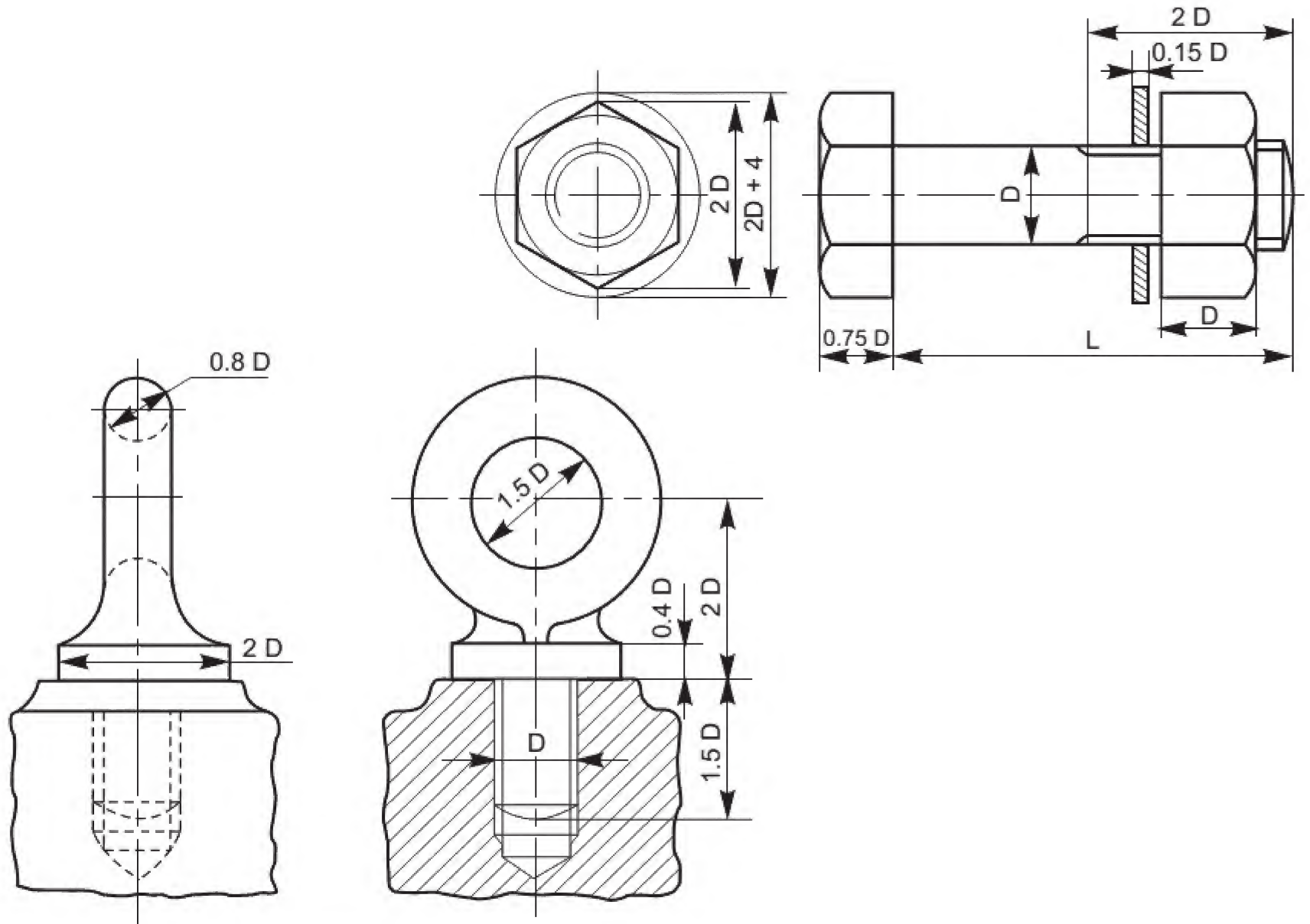


Fig. 5.21 Eye-bolt

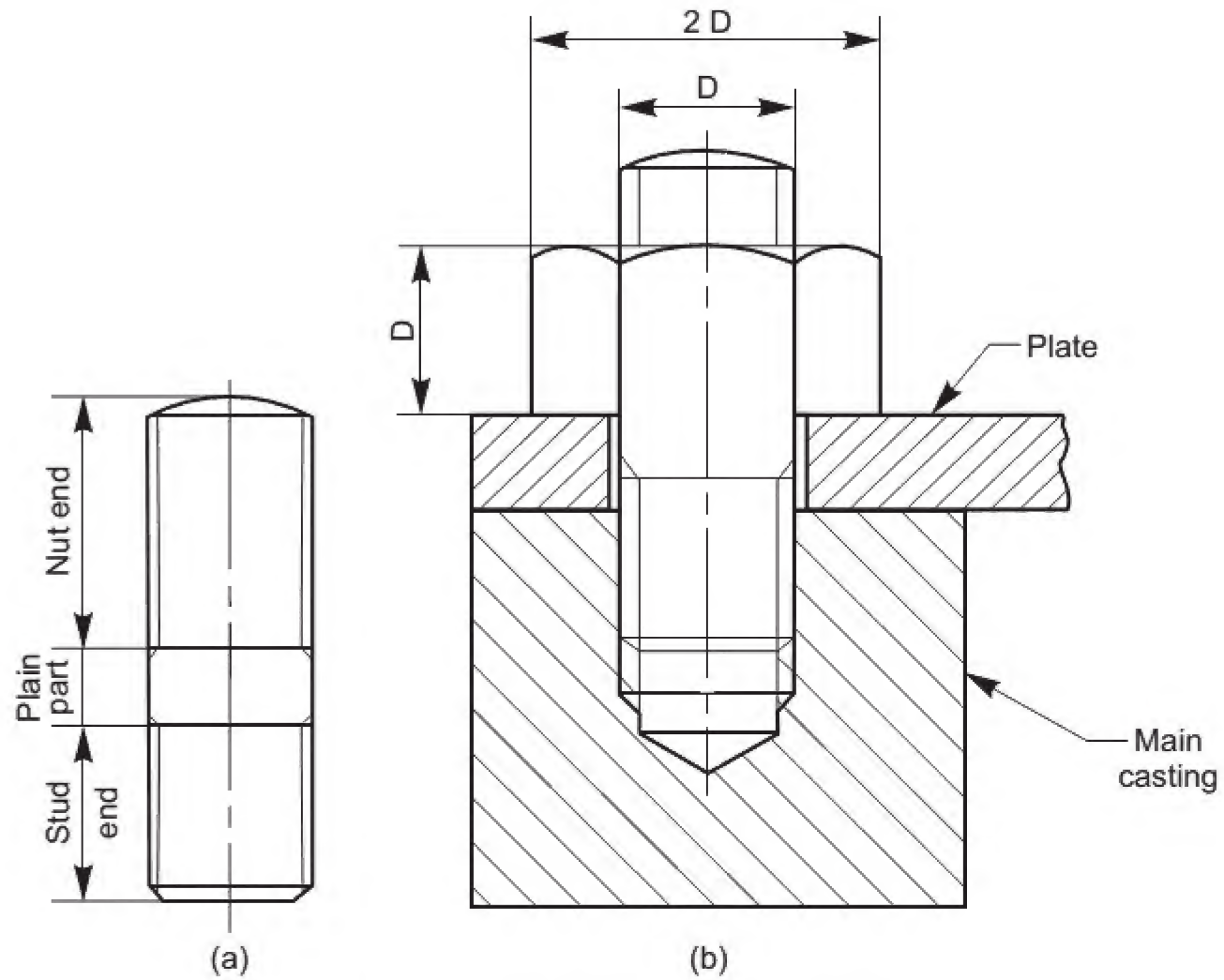


Fig. 5.22 (a)–Stud, (b)–Stud joint

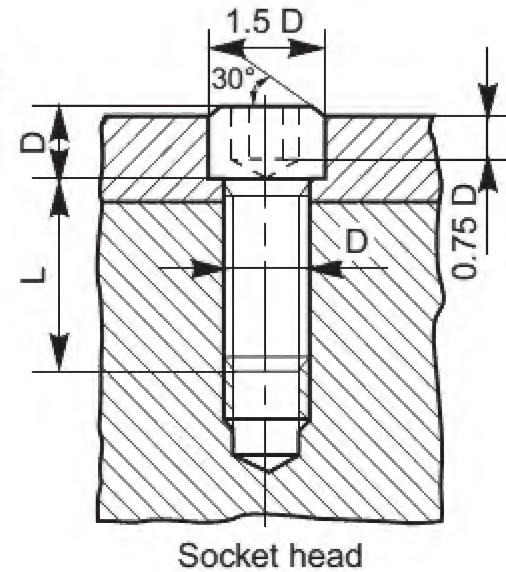
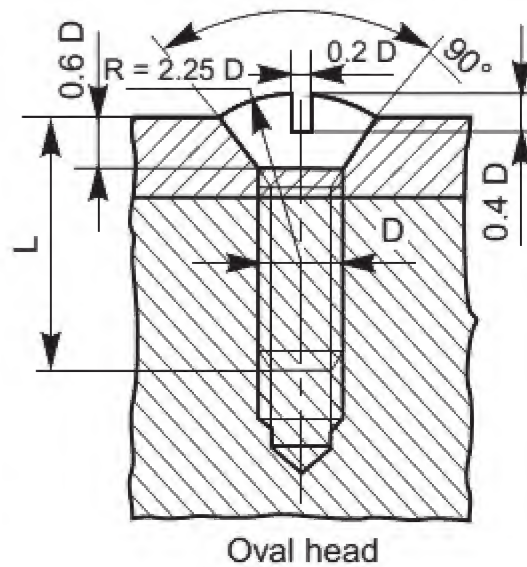
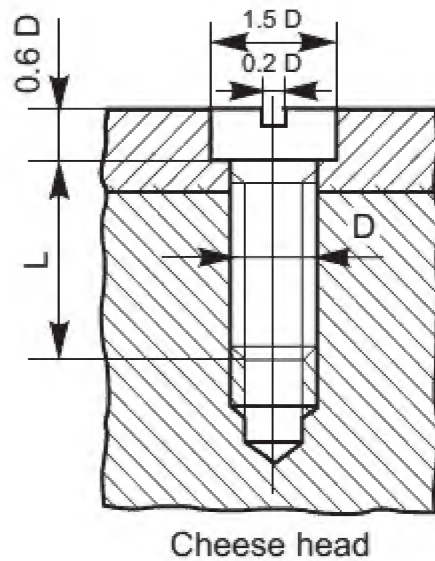
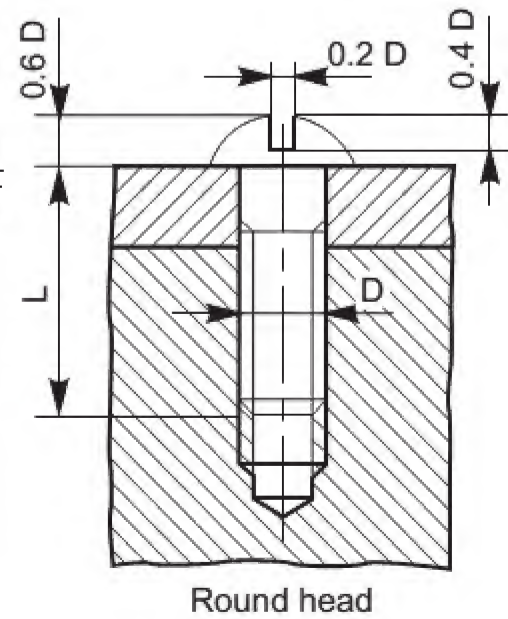
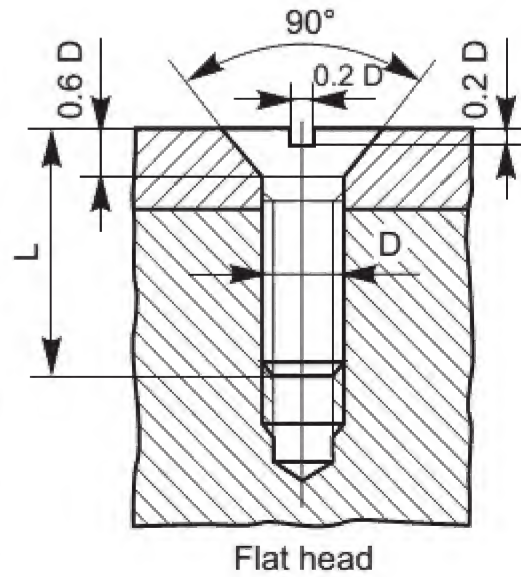
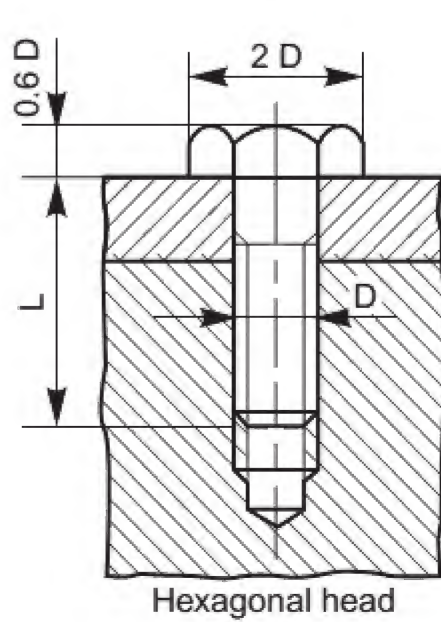


Fig. 5.24 Types of machine and cap screws

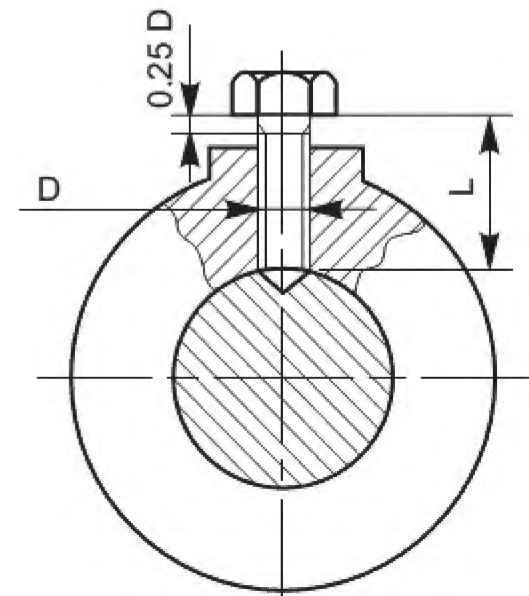
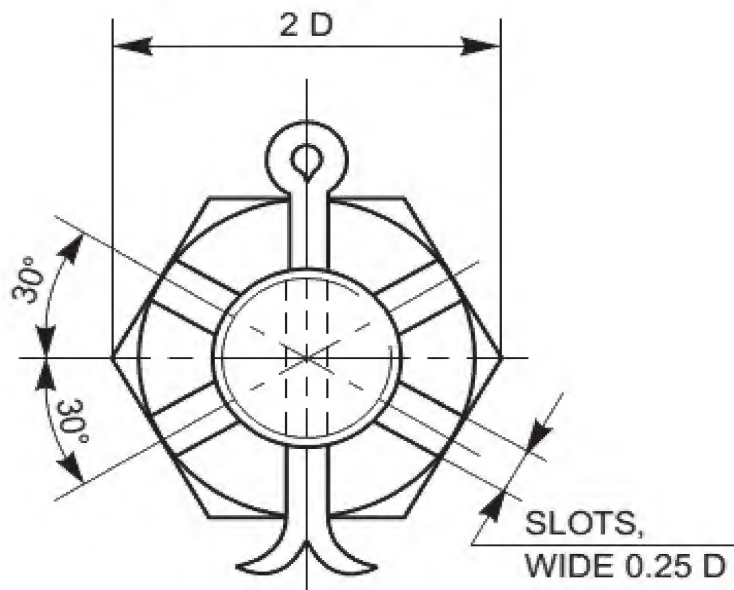
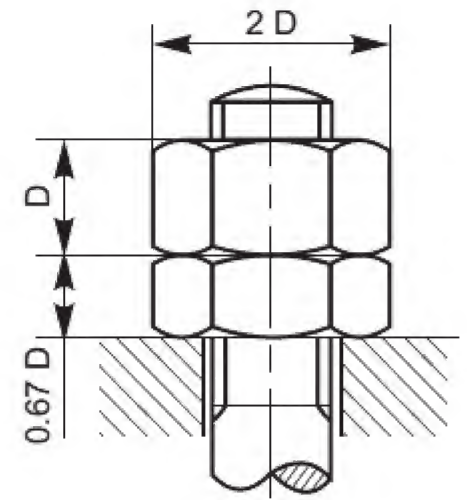
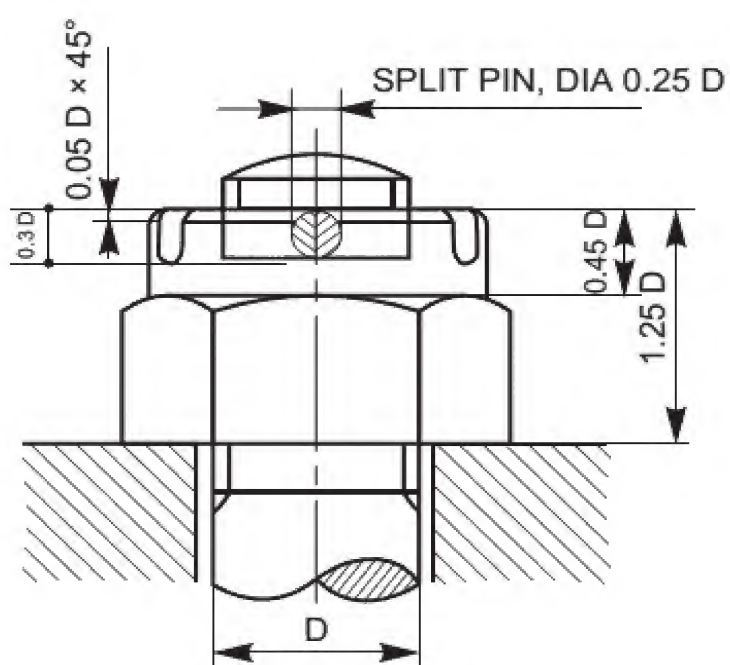


Fig. 5.29 Castle nut

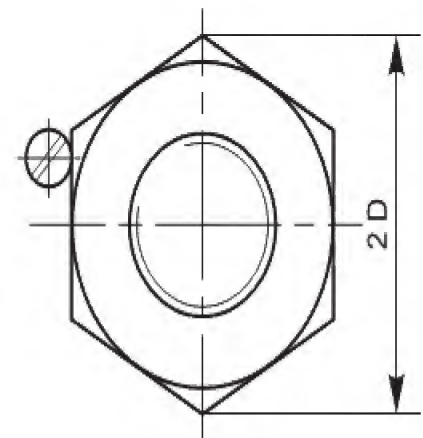
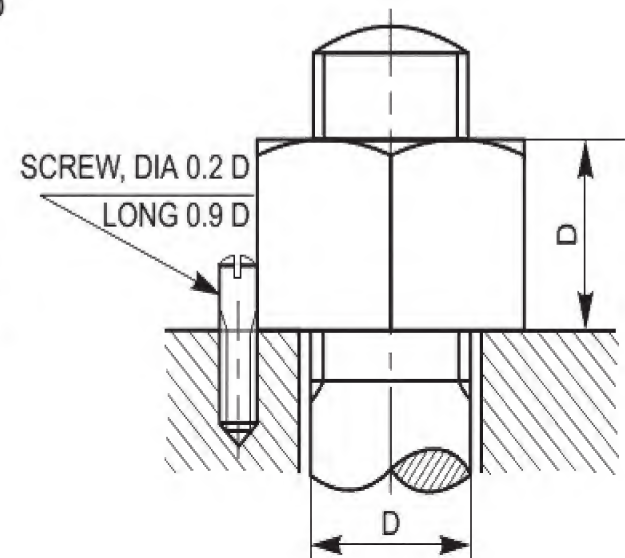
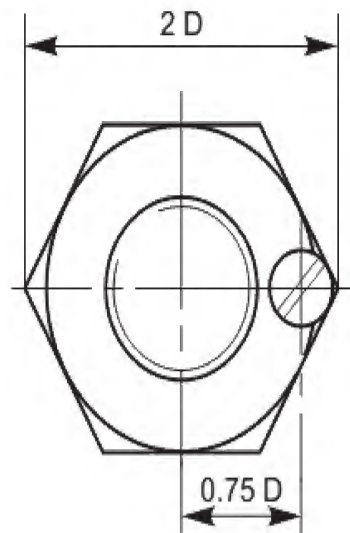
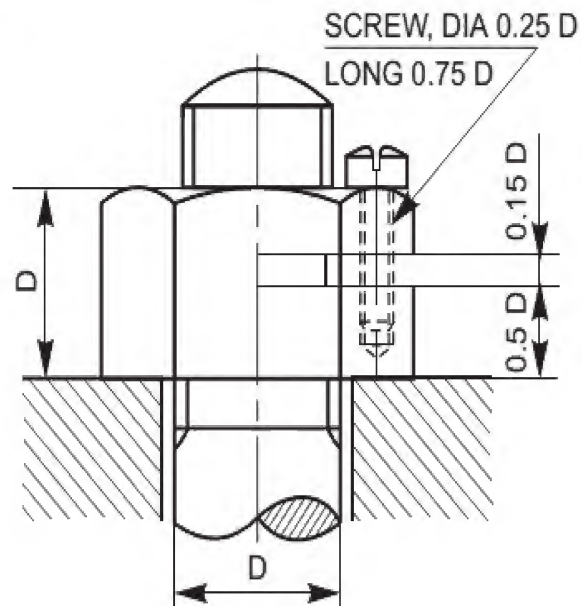
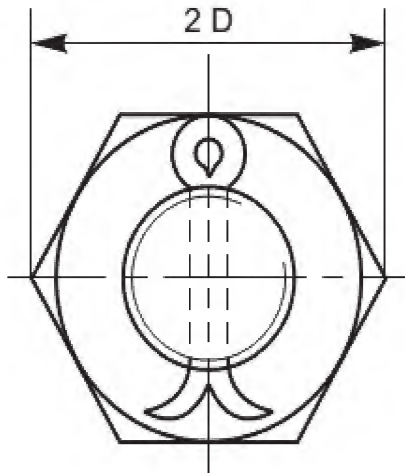
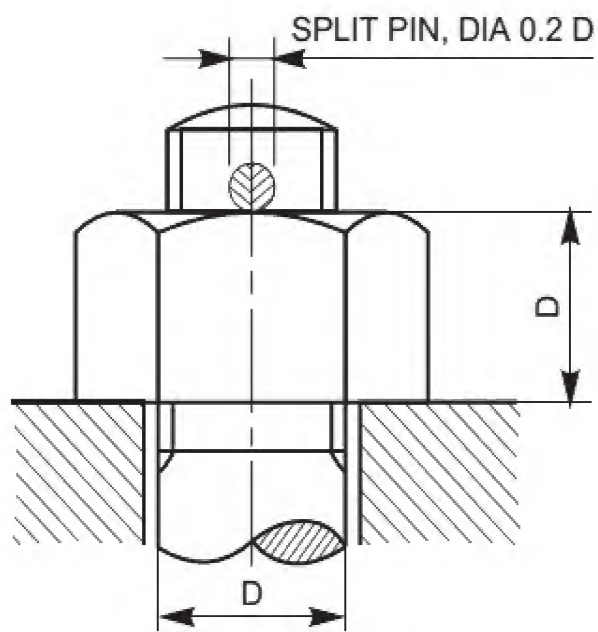


Fig. 5.28 Locking by split pin

Fig. 5.30 Wile's lock nut

Fig. 5.31 Locking by set screw

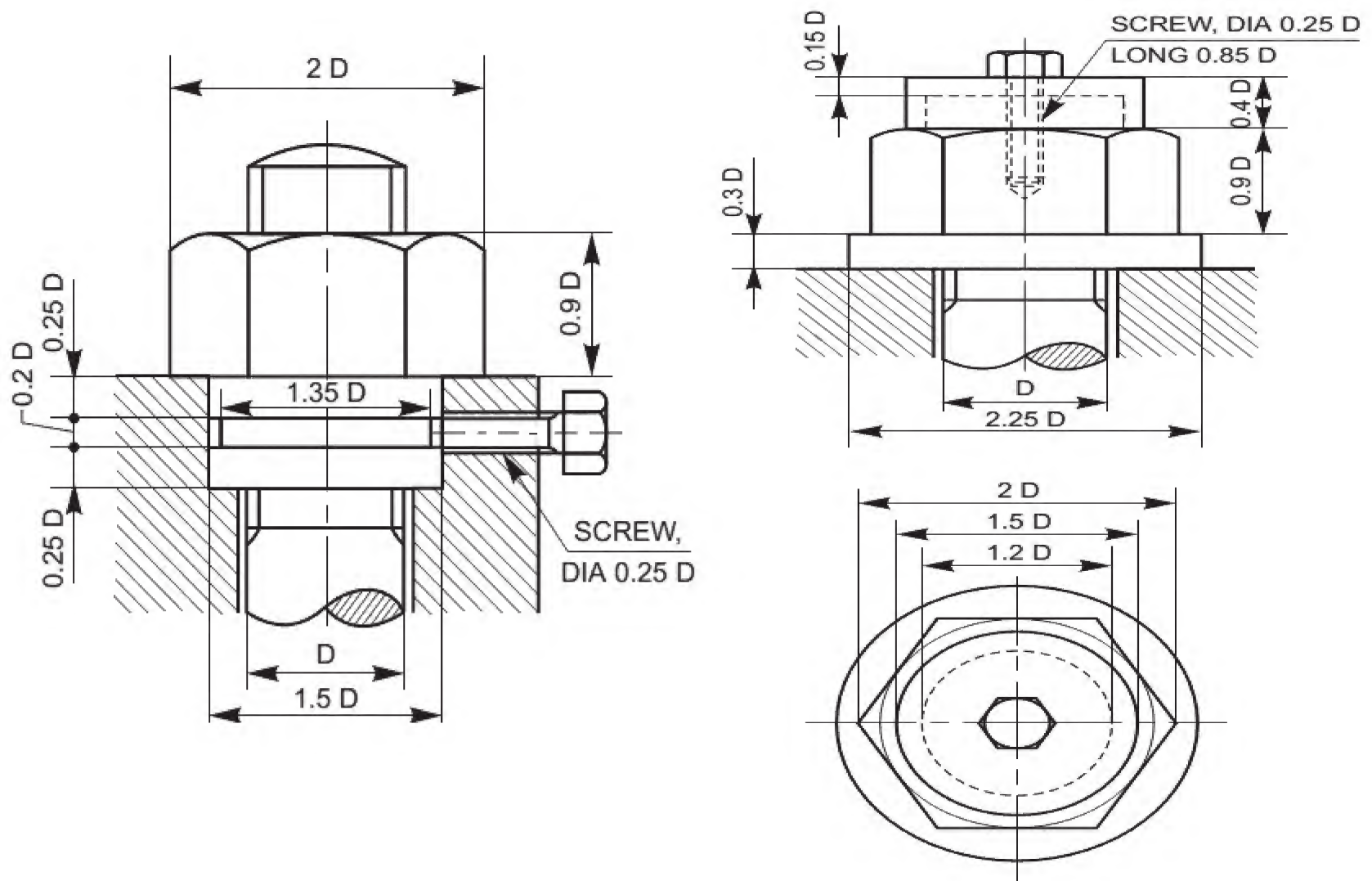


Fig. 5.33 Locking by screw

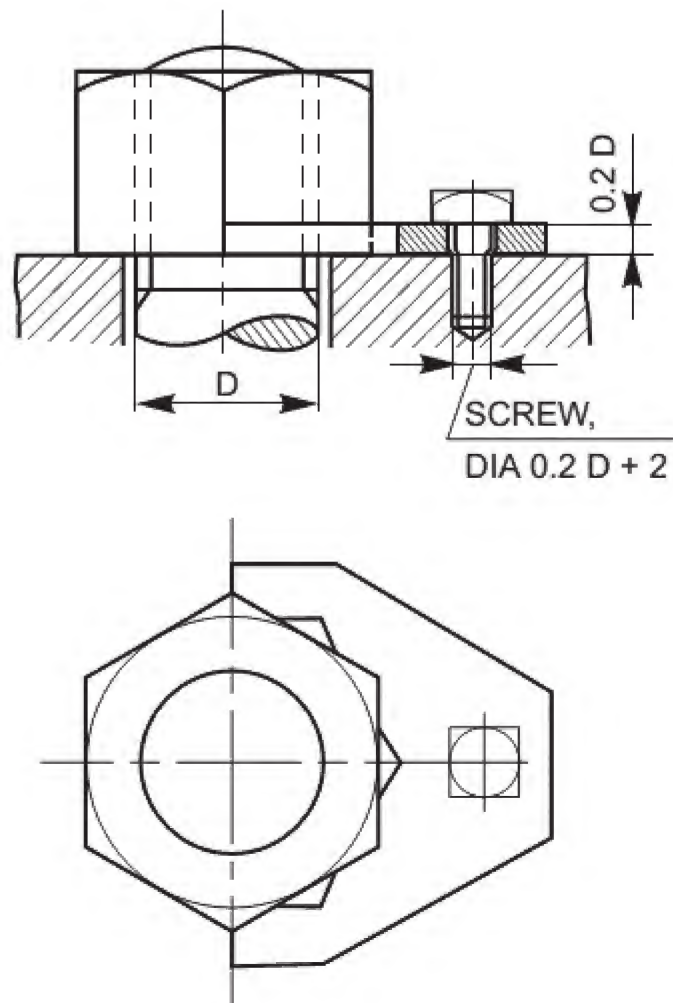


Fig. 5.34 Locking by plate

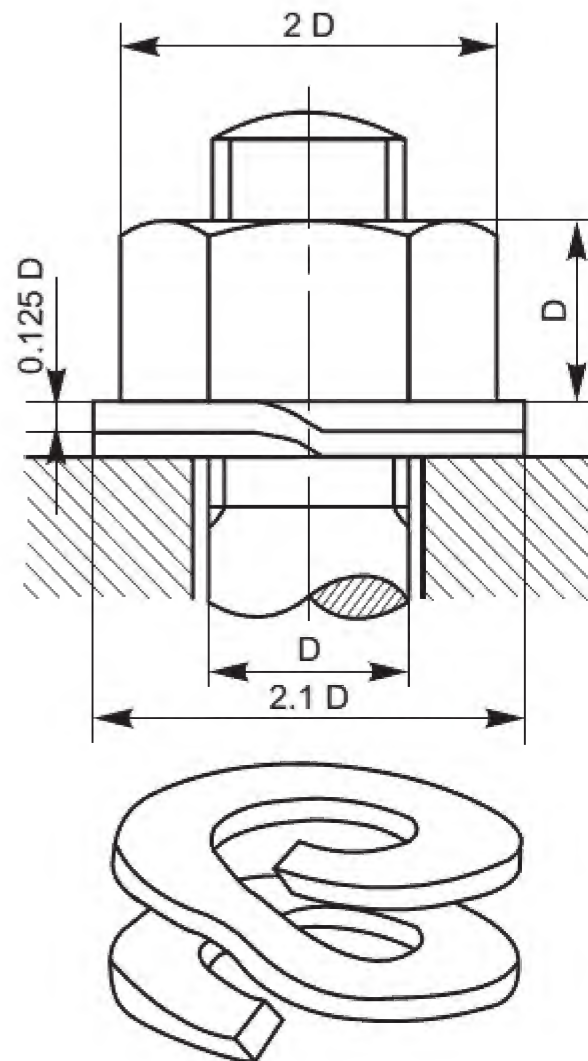


Fig. 5.35 Locking by spring washer

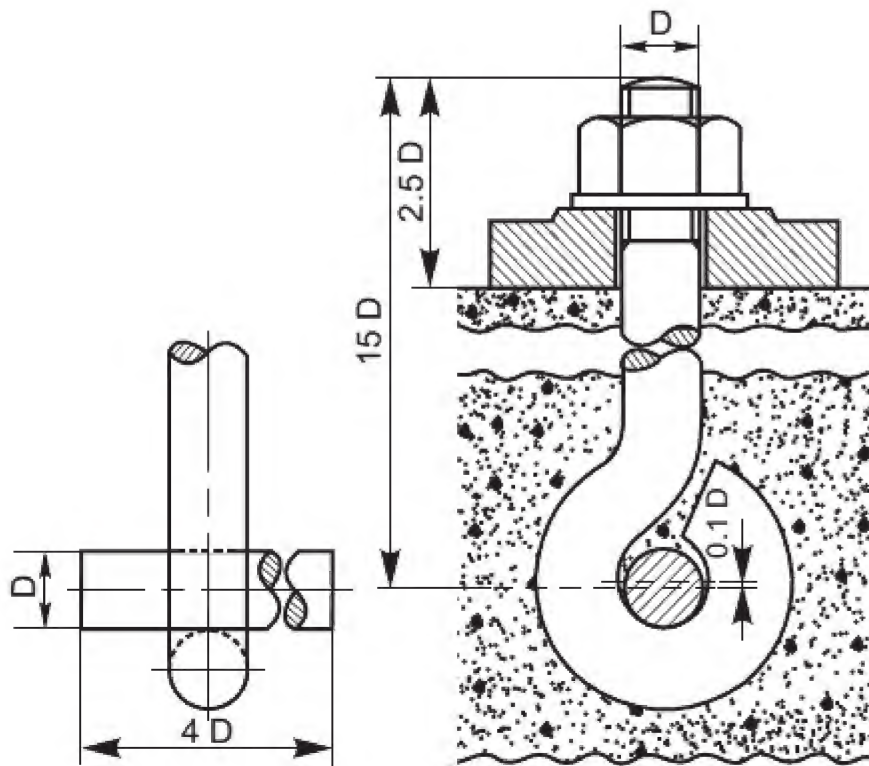


Fig. 5.36 Eye foundation bolt

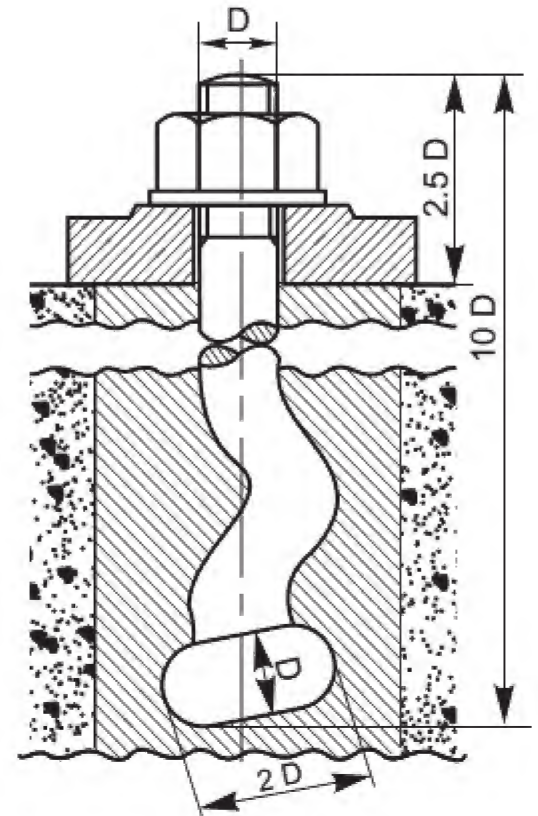


Fig. 5.37 Bent foundation bolt

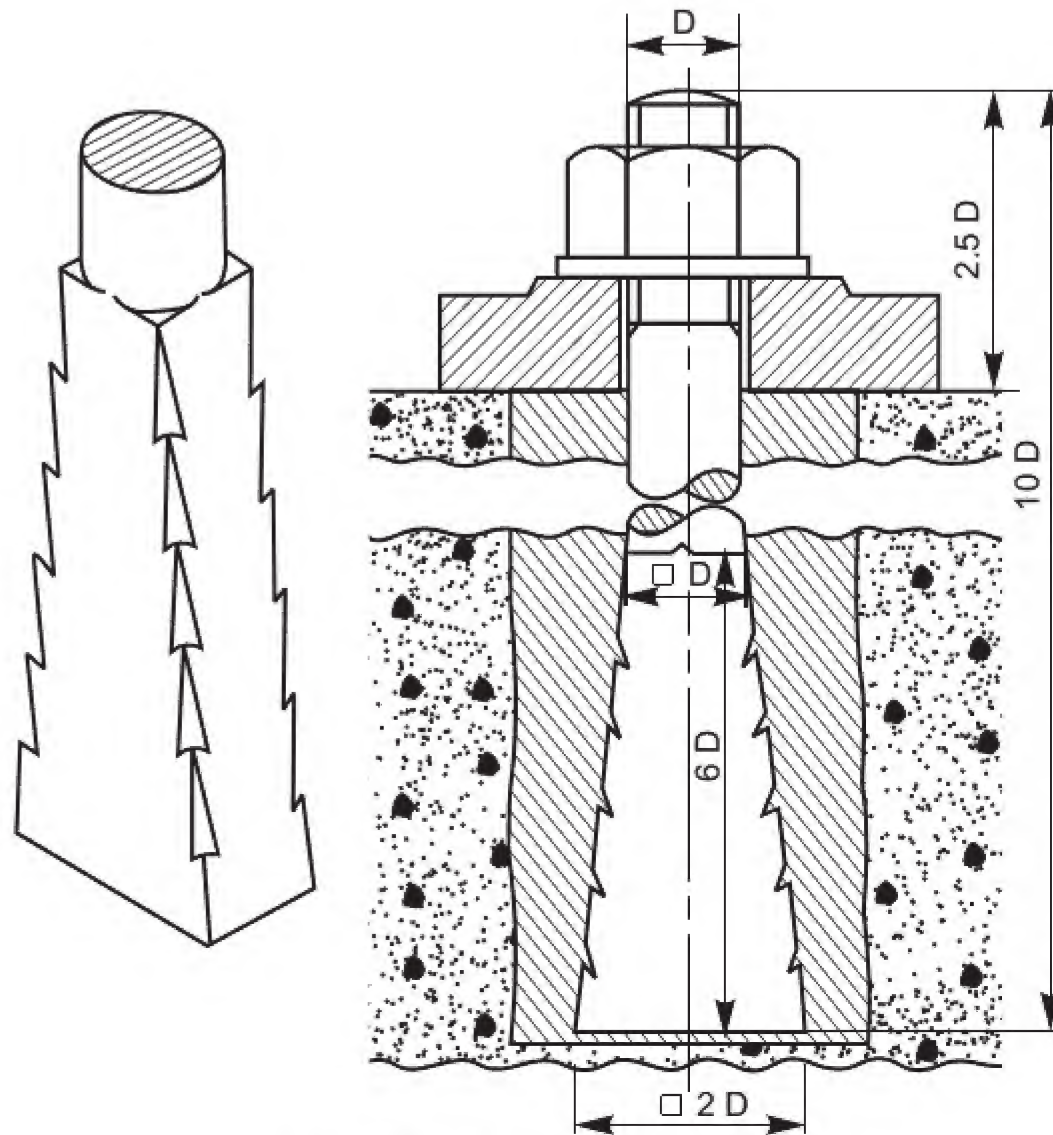


Fig. 5.38 Rag foundation bolt

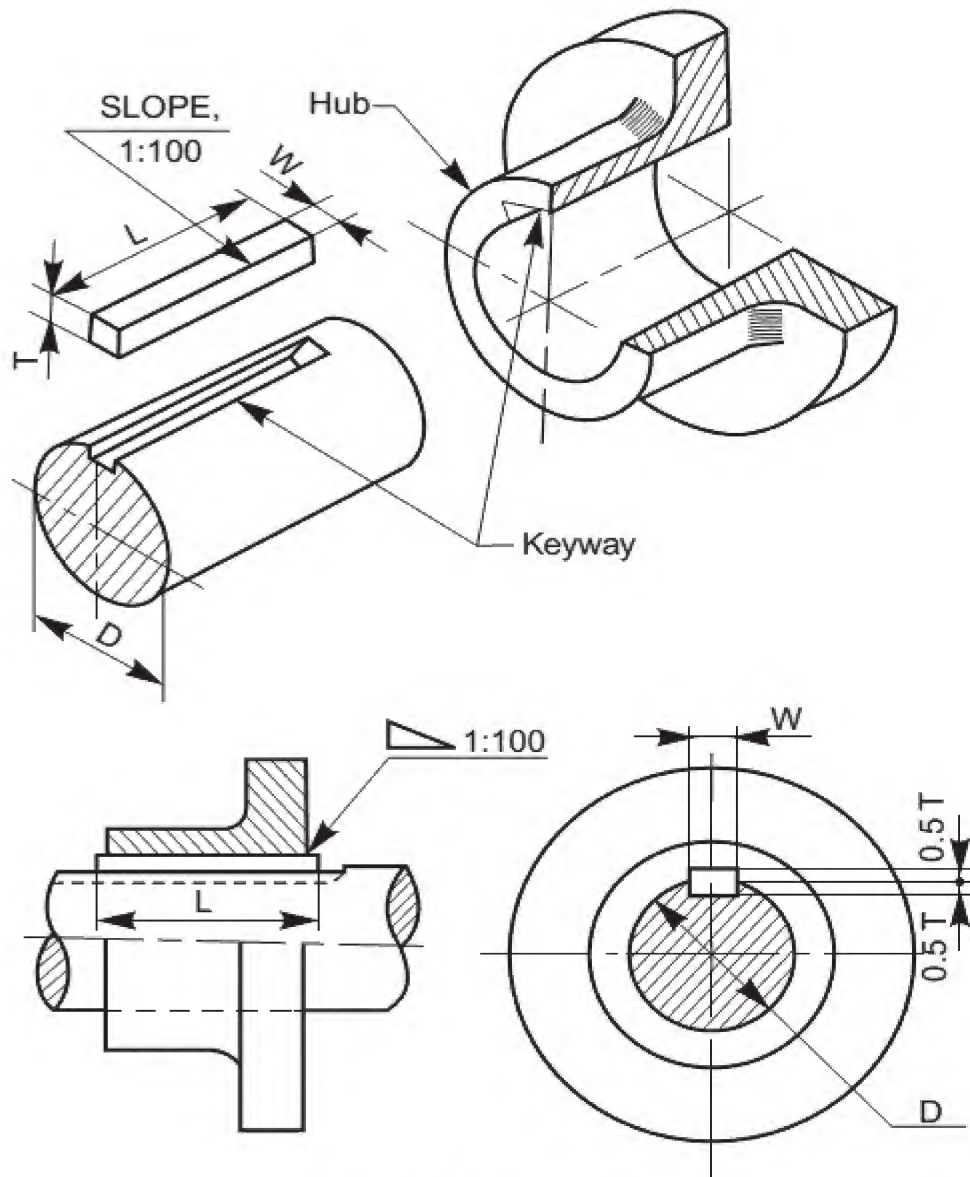


Fig. 6.1 Keyed joint

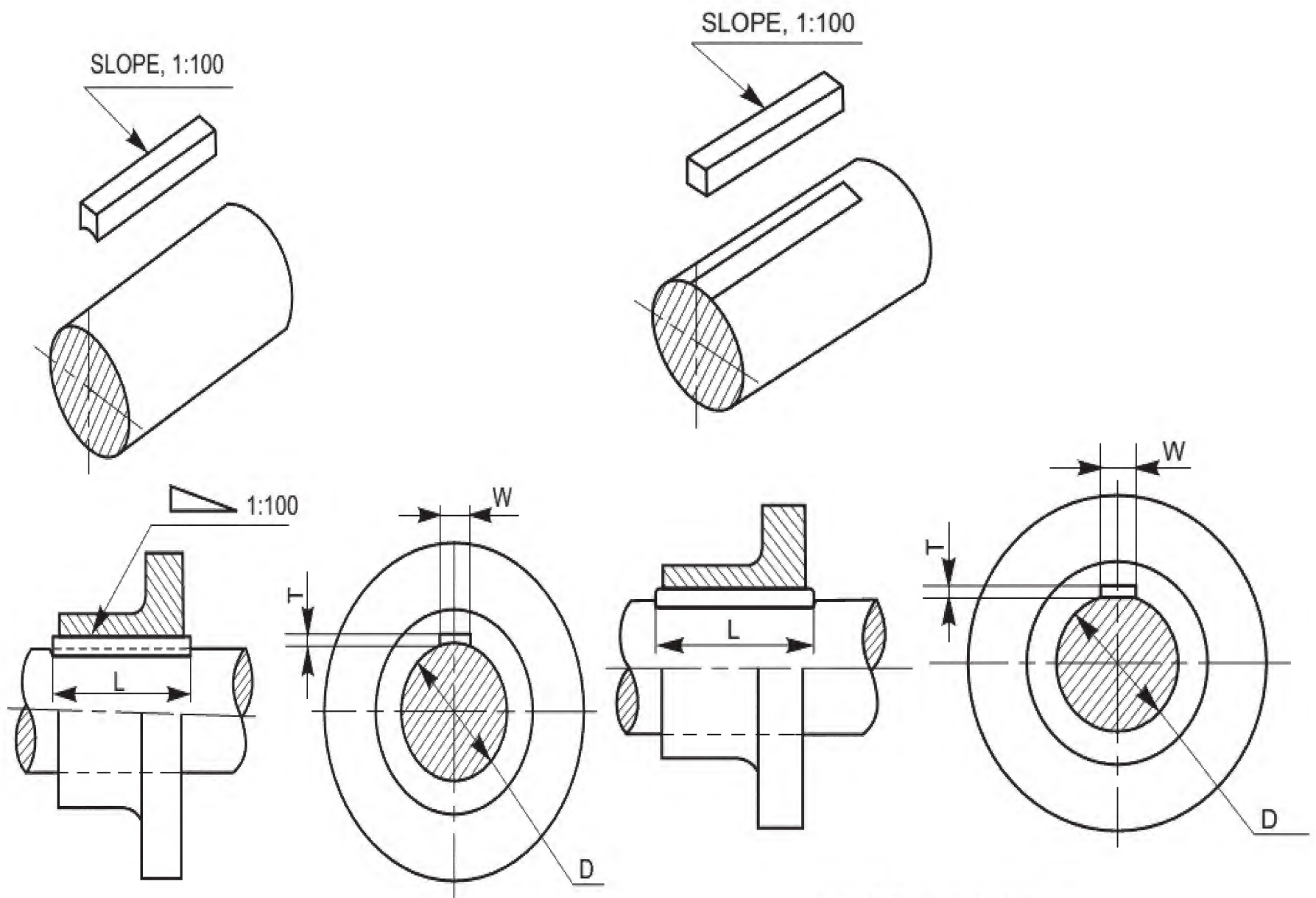


Fig. 6.2 Hollow saddle key

Fig. 6.3 Flat saddle key

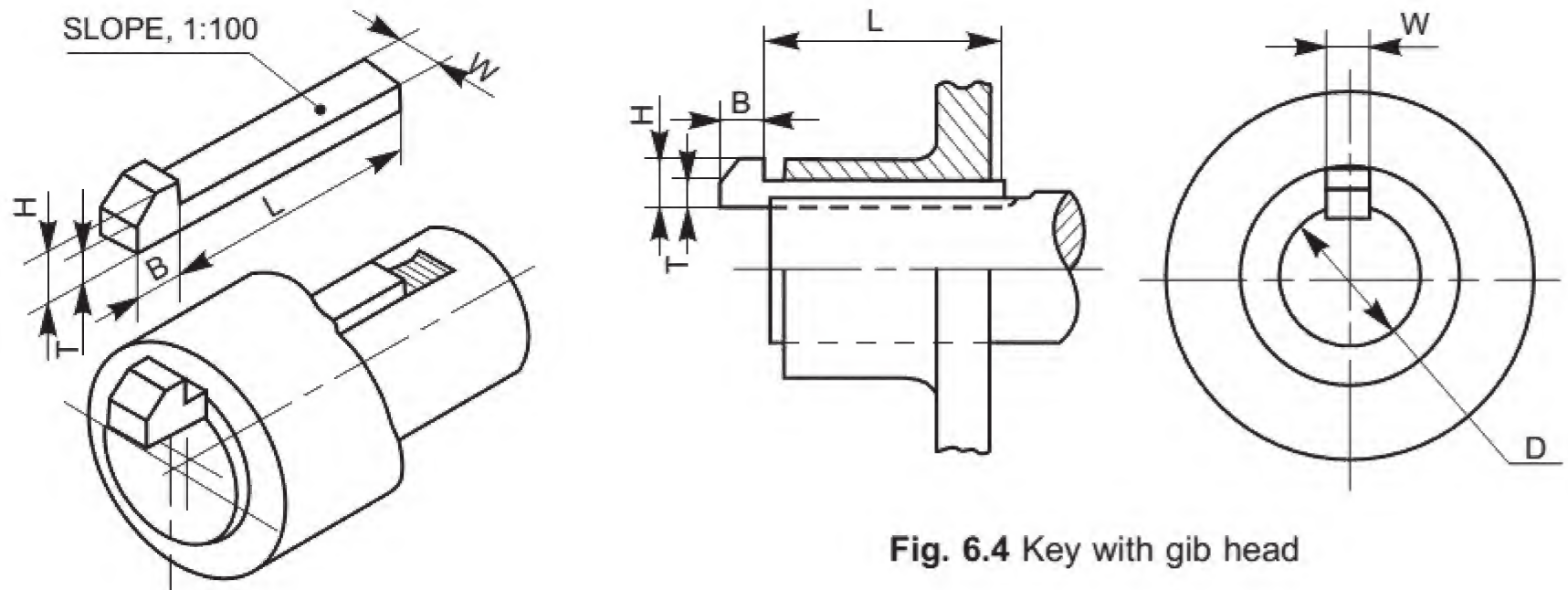


Fig. 6.4 Key with gib head

Table 6.1 Proportions of taper sunk keys for various shaft sizes (contd.)

<i>Shaft diameter (mm)</i>		<i>Width, W (mm)</i>	<i>Thickness, T (average value) (mm)</i>
<i>Over</i>	<i>Upto and including</i>		
6	8	2	2
8	10	3	3
10	12	4	4

<i>Shaft diameter (mm)</i>		<i>Width, W (mm)</i>	<i>Thickness, T (average value) (mm)</i>
<i>Over</i>	<i>Upto and including</i>		
12	17	5	5
17	22	6	6
22	30	8	7
30	38	10	8
38	44	12	8
44	50	14	9
50	58	16	10
58	65	18	11
65	75	20	12
75	85	22	14
85	95	25	14
95	110	28	16

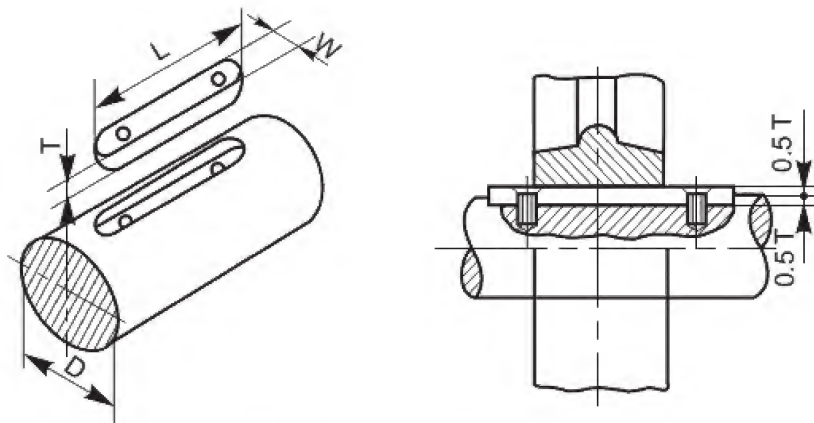


Fig. 6.5 Parallel sunk key

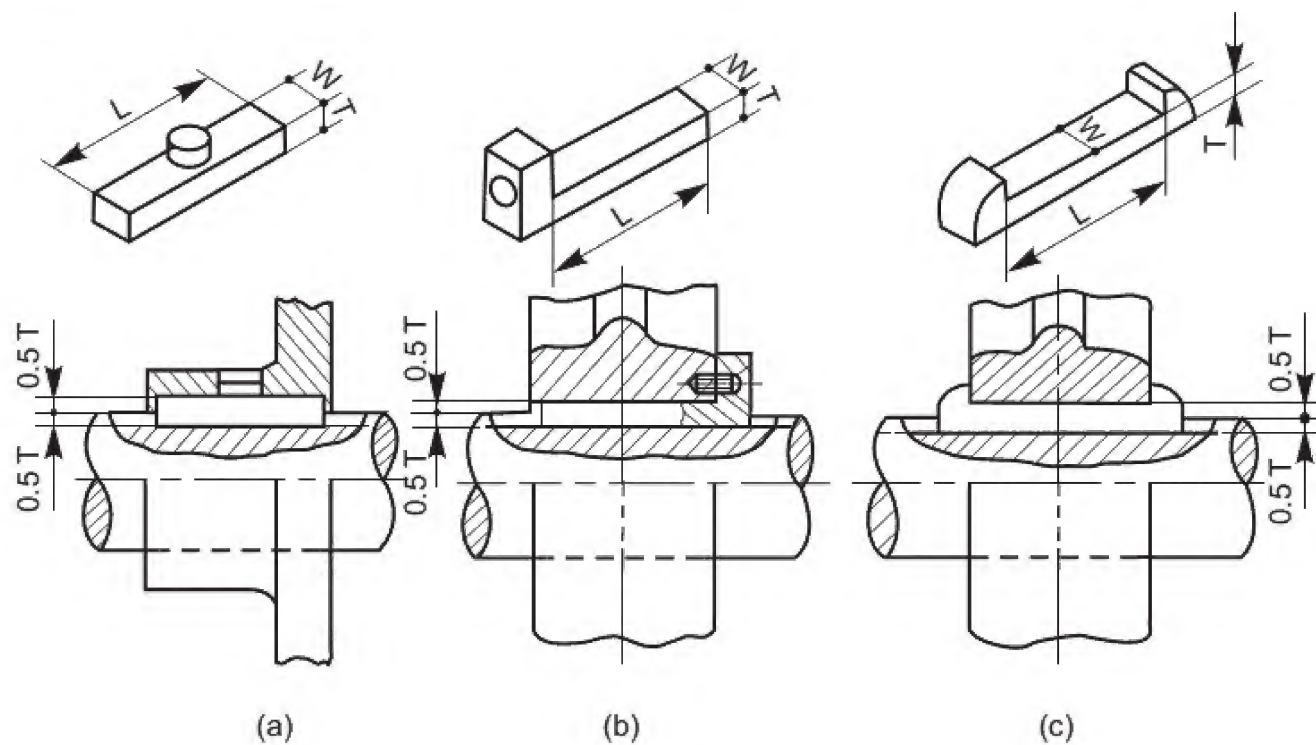


Fig. 6.6 Feather keys

6.2.2.3 Splines

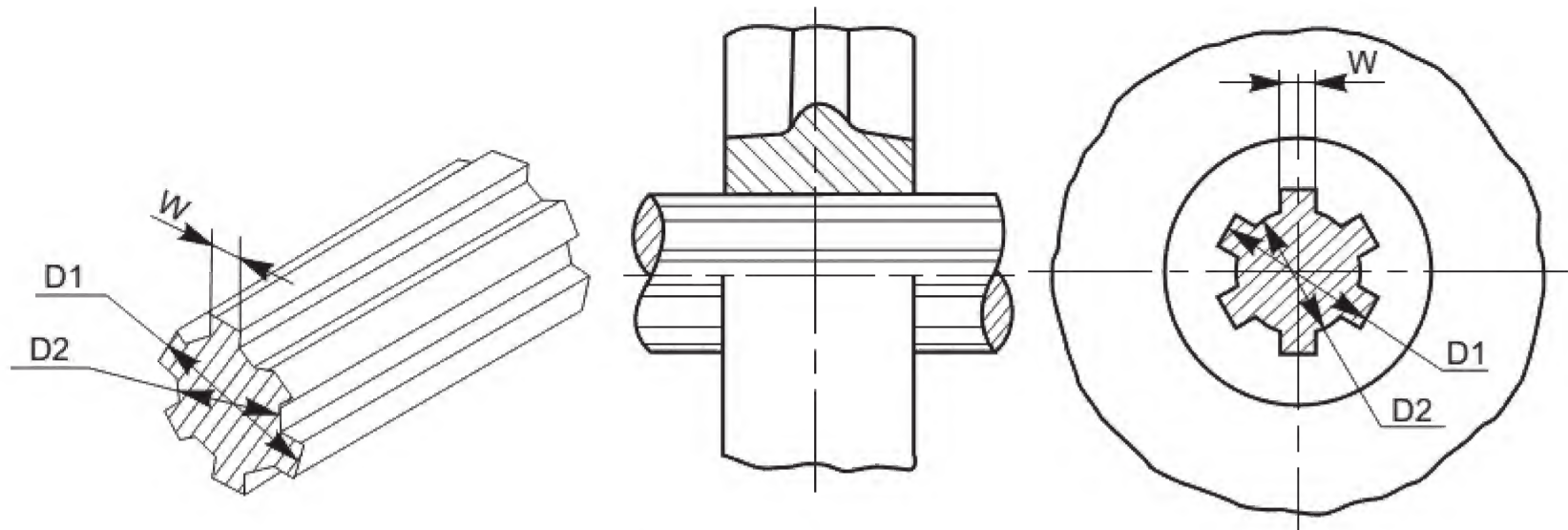


Fig. 6.7 Splined shaft and hub

Table 6.2 Proportions for splined shafts of various sizes

<i>Nominal (major) diameter, D_1 (mm)</i>	<i>Number of splines</i>	<i>Minor (root) diameter, D_2 (mm)</i>	<i>Width of spline, W (mm)</i>
14	6	11	3
16	6	13	3.5
20	6	16	4
22	6	18	5
25	6	21	5
28	6	23	6
32	6	26	6
34	6	28	6
38	8	32	7
42	8	36	7
48	8	42	8
54	8	46	9
60	8	52	10
65	8	56	10
72	8	62	12
82	10	72	12
92	10	82	12
102	10	92	14

6.2.2.4 Woodruff Key

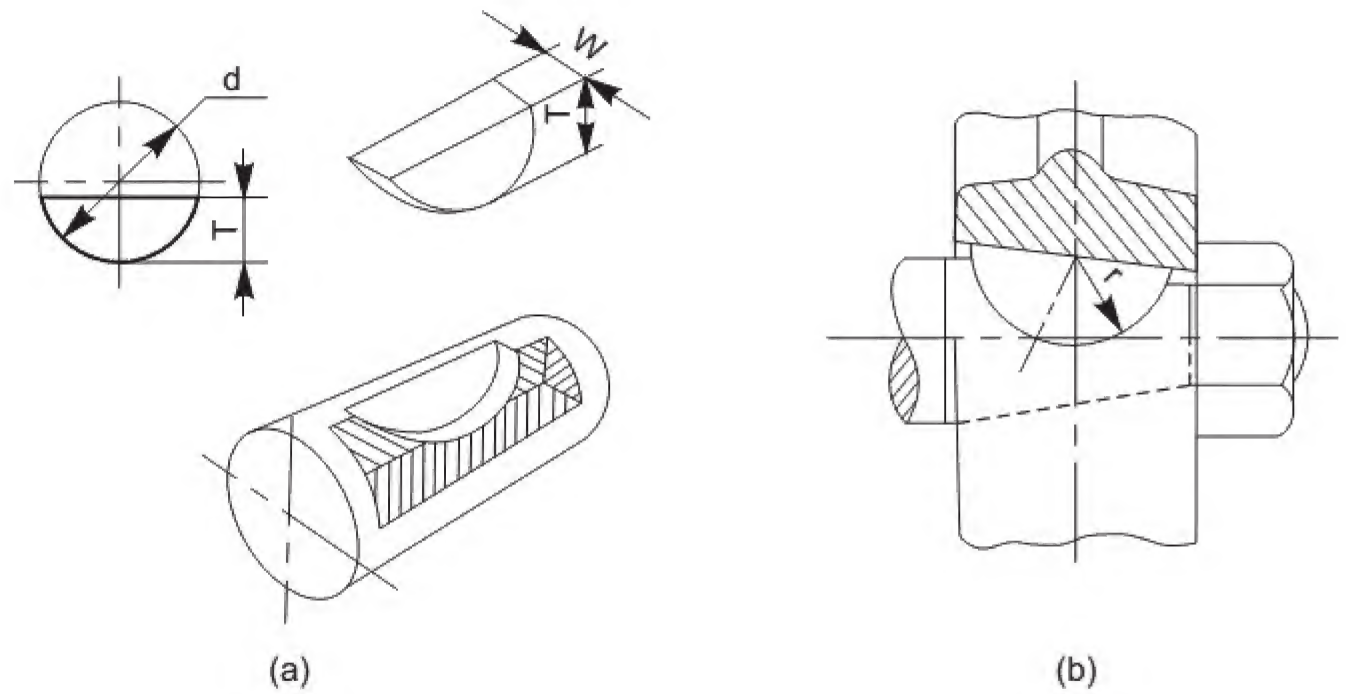


Fig. 6.8 Woodruff key

6.2.2.5 Round Keys

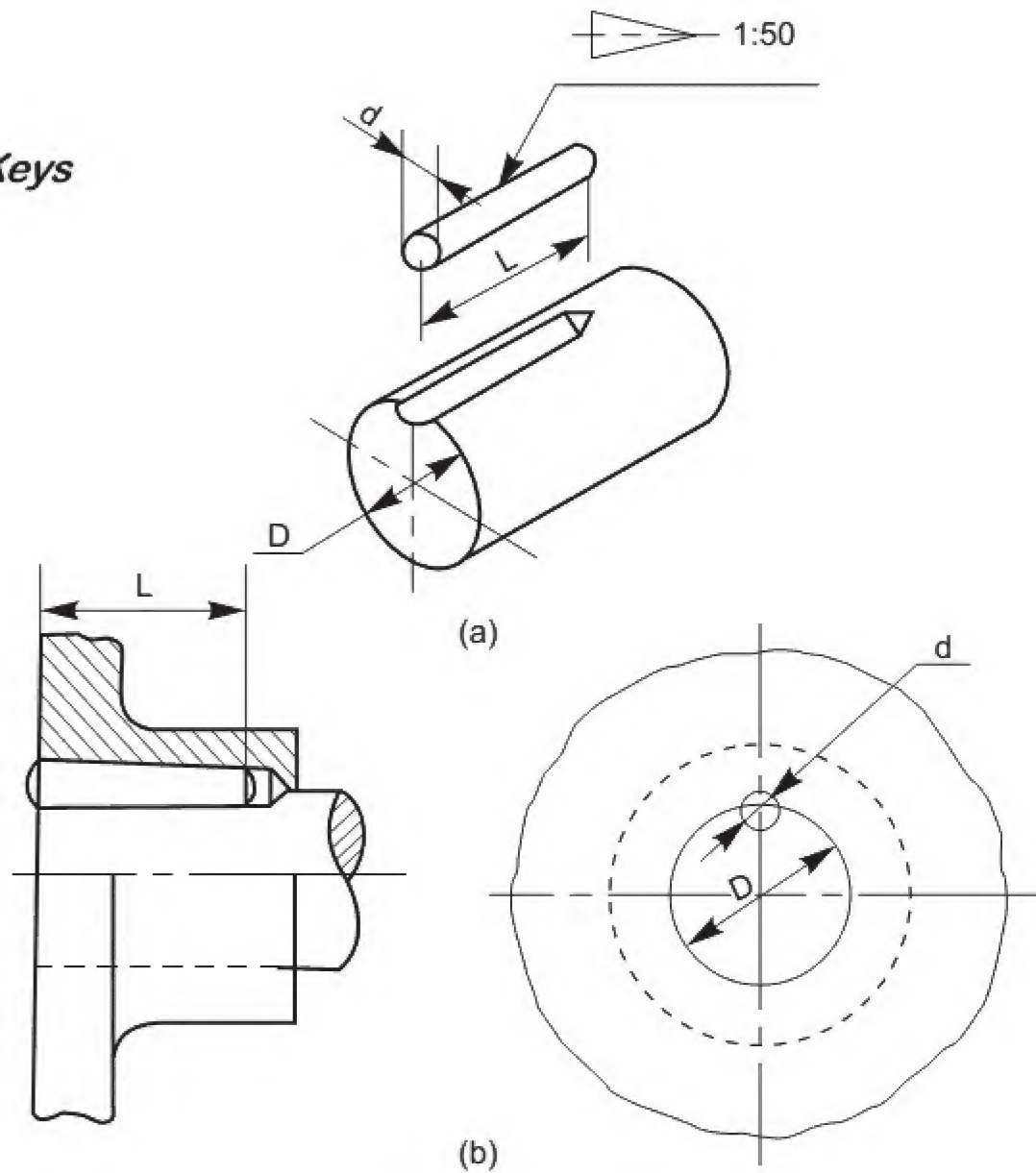


Fig. 6.9 Round key

6.3 COTTER JOINTS

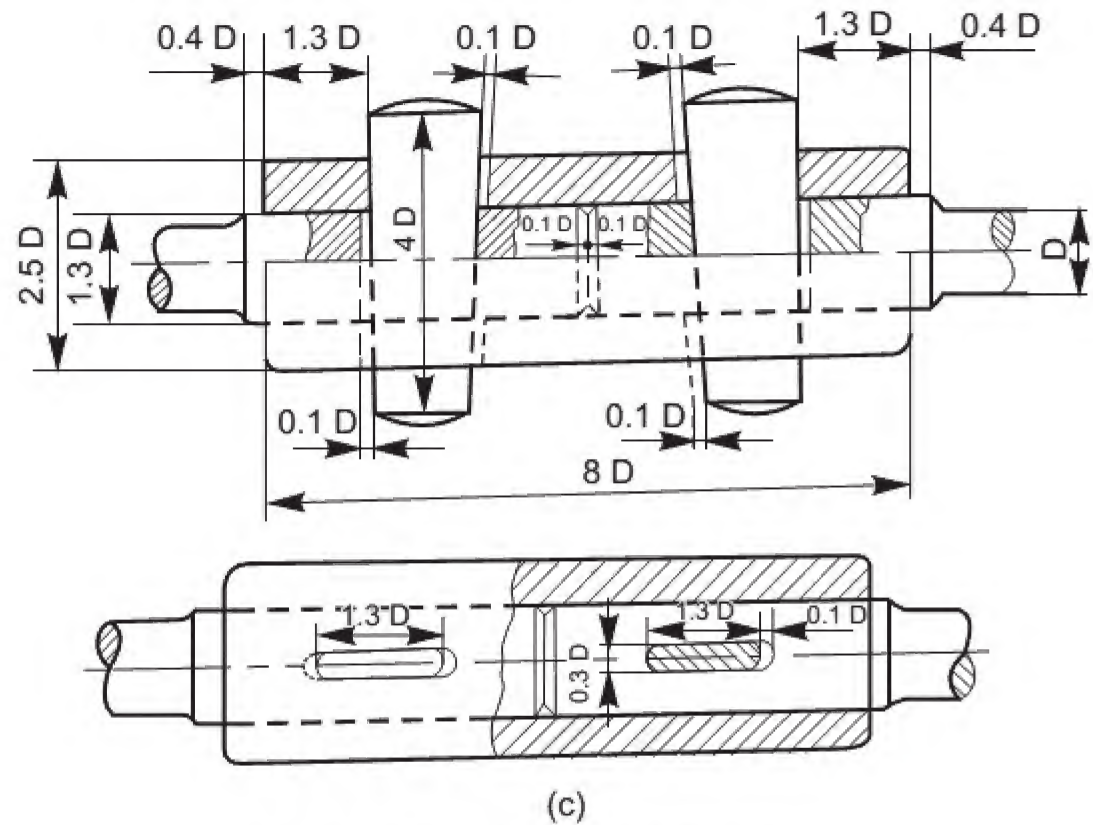


Fig. 6.12 Cotter joint with sleeve

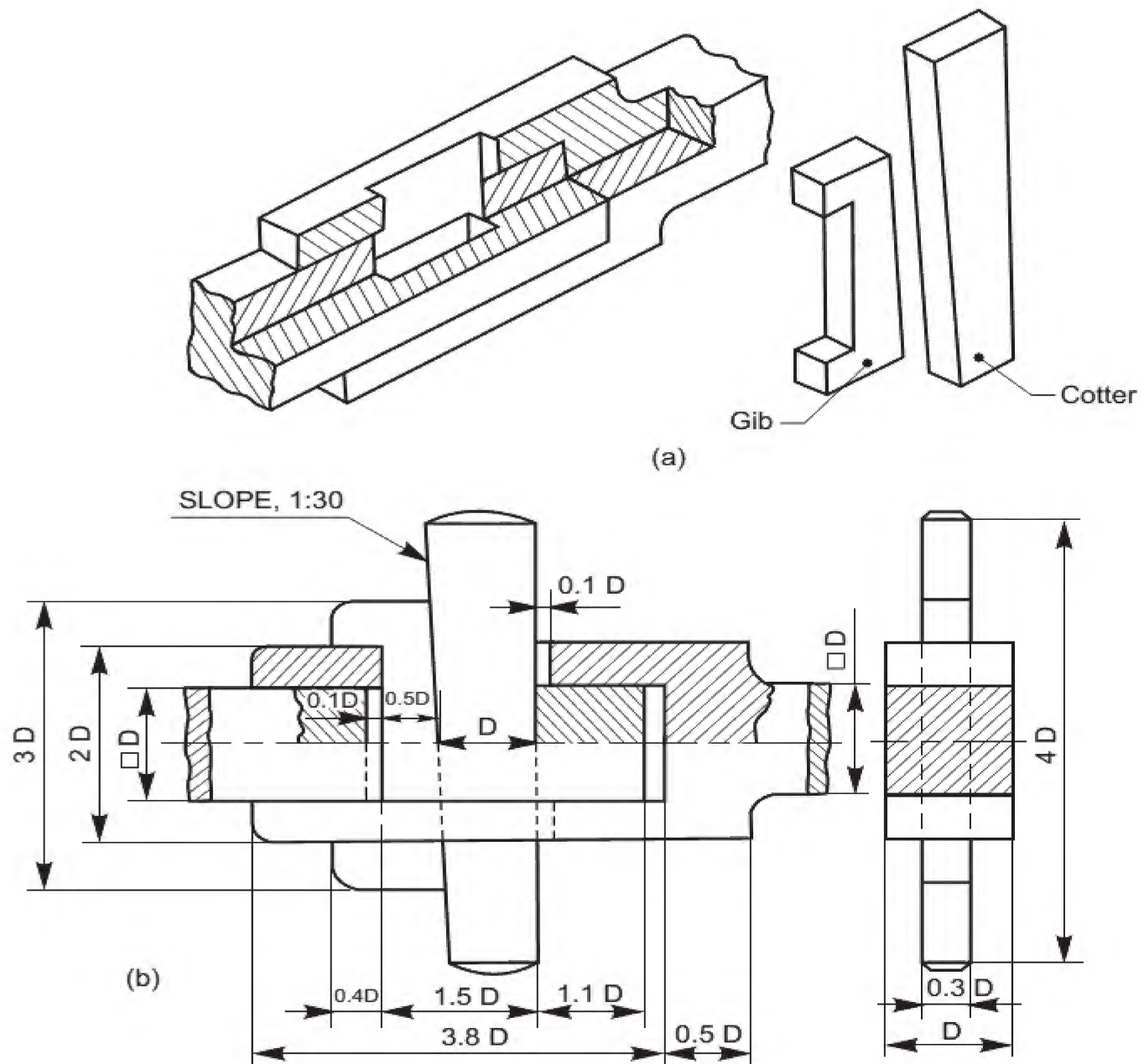


Fig. 6.14 Cotter joint with a gib

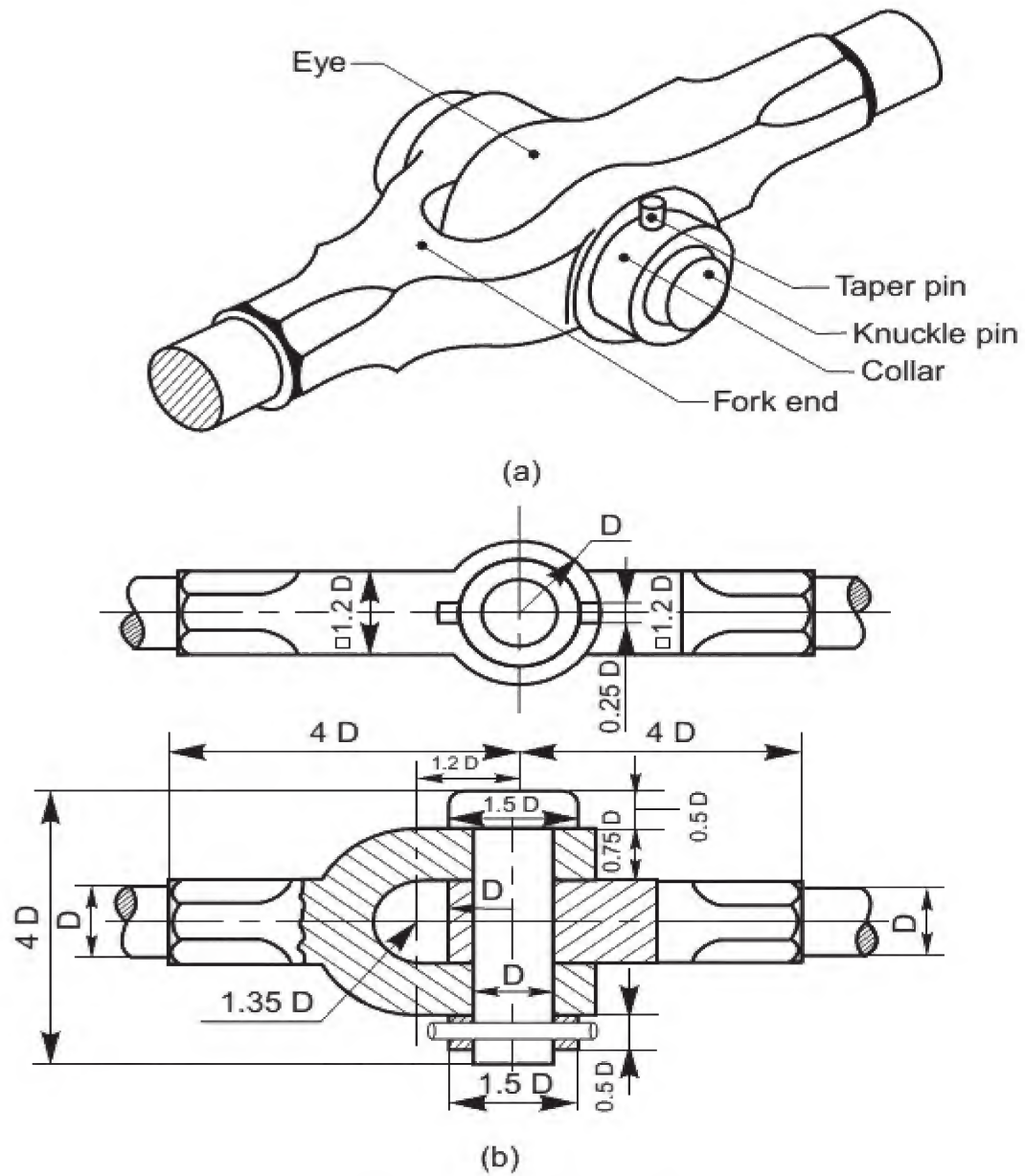
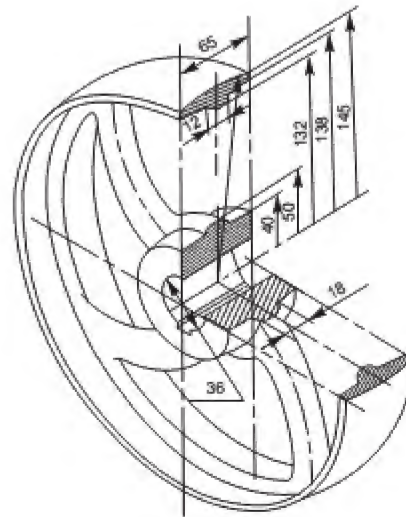


Fig. 6.15 Knuckle joint



(a)

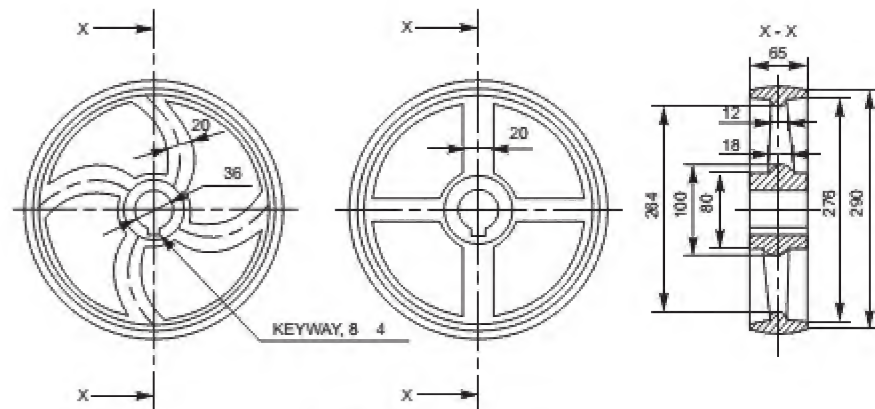


Fig. 9.1 Pulley with arms

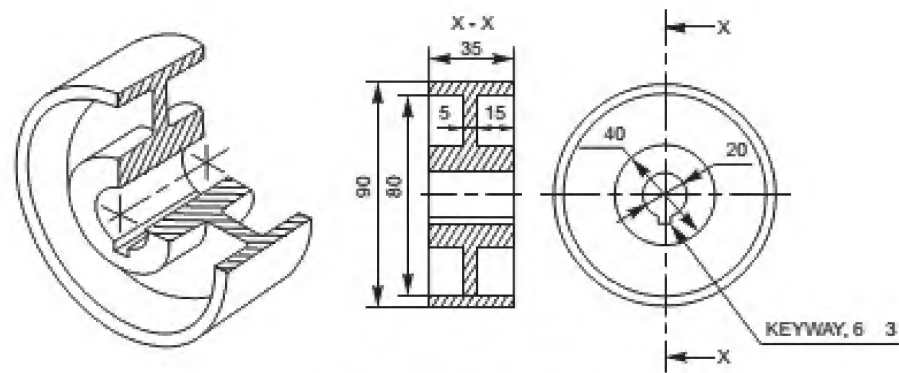


Fig. 9.2 Pulley with web

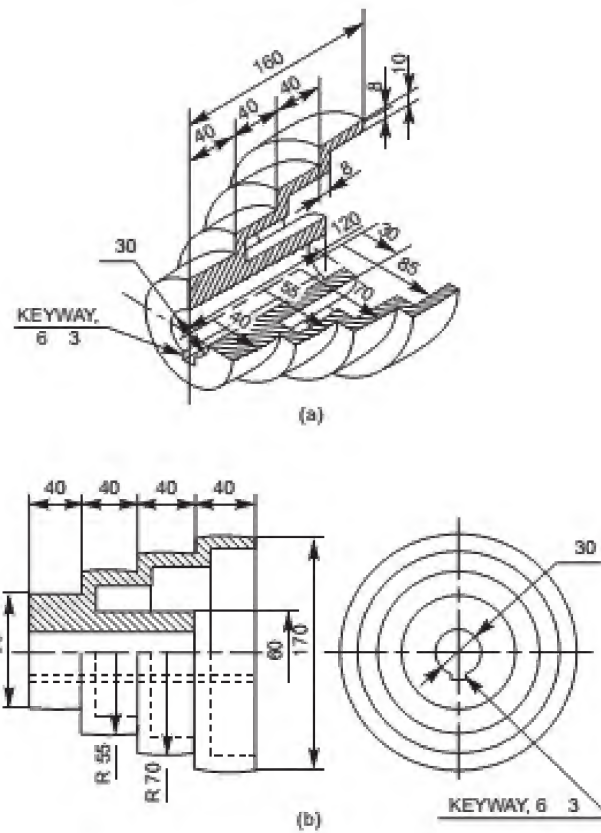


Fig. 9.3 Step cone pulley for flat belt drive

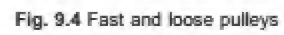
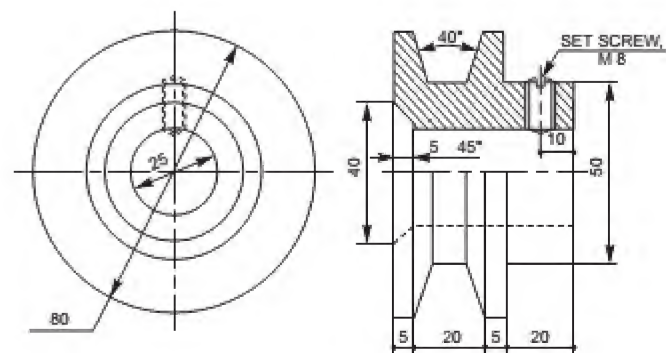
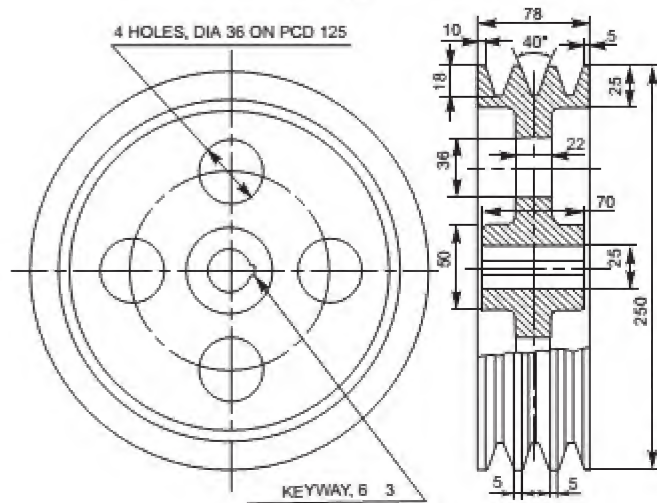


Fig. 9.4 Fast and loose pulleys

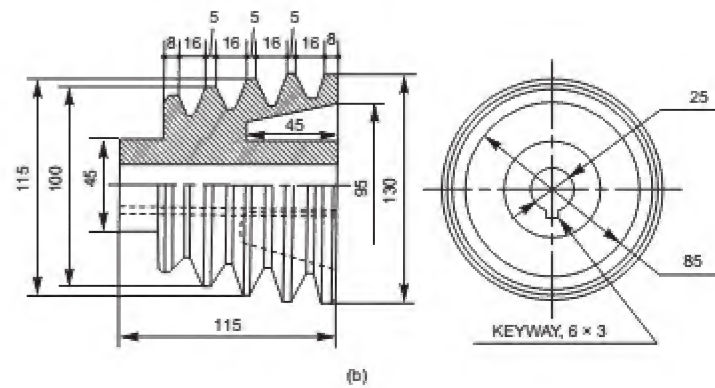
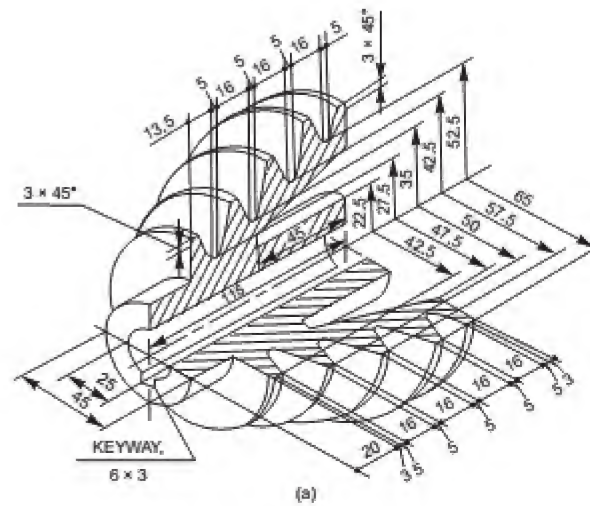


(a)



(b)

Fig. 9.5 V-belt pulleys



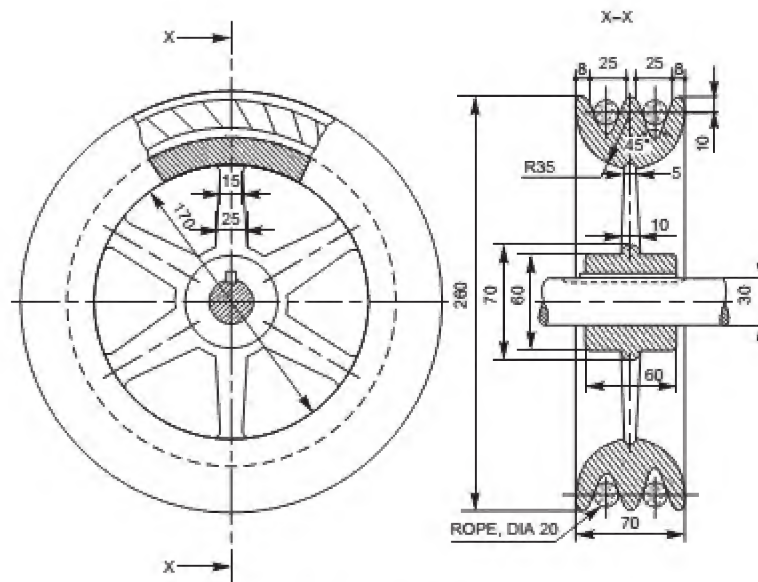


Fig. 9.7 Rope pulley

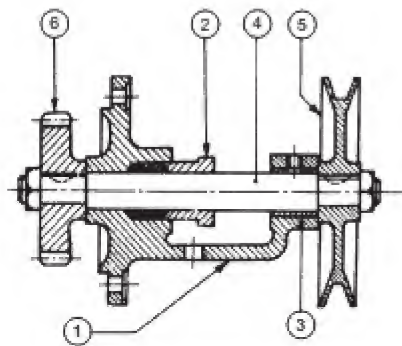


Fig. 18.50A V-belt drive

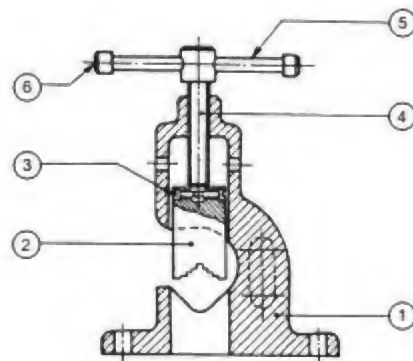


Fig. 18.52A Pipe vice